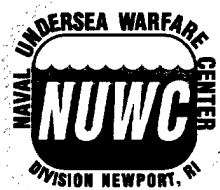


Seasonal Performance of a High-Frequency/ Automatic Link Establishment (HF/ALE) Radio Network Operating at Mid to High Latitudes in the Southern Hemisphere (Volume 2—Data Plots)

Patrick E. Gilles
Joseph R. Katan
NUWC Division Newport

Robert J. Pellowski
Tele-Technologies, Inc.



**Naval Undersea Warfare Center Division
Newport, Rhode Island**

Approved for public release; distribution unlimited.

PREFACE

This report was prepared under joint sponsorship of the Office of Naval Research (ONR), Submarine Communications Block Program (program element 62232N); the National Science Foundation, Office of Polar Programs (NFS/OPP); and the Naval Undersea Warfare Center (NUWC) Division Newport, Independent Research/Independent Exploratory Development Program (program element 62936N). The principal investigator for this task was Joseph R. Katan (Code 3411); program manager for the ONR Submarine Communications Program is Frederick C. Allard (Code 3496); the NSF/OPP project engineer is Patrick Smith. The ONR project sponsor is Sherman Gee (ONR 313); program manager for ONR research funding at NUWC Division Newport is Richard B. Philips (Code 102).

The technical reviewer for this report was Basile Panoutsopoulos (Code 3413).

The authors would like to thank the many people who contributed to the success of this enormous undertaking. Special thanks to Brian L. Pease and Paul M. Mileski for their support in Antarctica and to Edwin A. Wolkoff for his creative insight. Thanks go to Patrick C. Smith, sponsor at NSF/OPP, who persisted in making the required links, to the men and women of the U.S. Navy stationed at the U.S. Naval Support Force, Antarctica Detachment (Christchurch, New Zealand) and the personnel at the Antarctic Support Unit who have been associated with this task. Finally, a special thanks to the other half of the team, our mates down under at the Defence Science and Technology Organisation and the Australian Antarctic Division, particularly to John R. Tilbrook, our Australian counterpart.

Reviewed and Approved: 7 May 1999



Joe Perry
Head, Submarine Electromagnetic Systems Department



| REPORT DOCUMENTATION PAGE | | | Form Approved OMB No. 0704-0188 | |
|---|---|---|---------------------------------------|--|
| <small>Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.</small> | | | | |
| 1. AGENCY USE ONLY (Leave Blank) | 2. REPORT DATE 7 May 1999 | 3. REPORT TYPE AND DATES COVERED Final | | |
| 4. TITLE AND SUBTITLE SEASONAL PERFORMANCE OF A HIGH-FREQUENCY/AUTOMATIC LINK ESTABLISHMENT (HF/ALE) RADIO NETWORK OPERATING AT MID TO HIGH LATITUDES IN THE SOUTHERN HEMISPHERE (VOLUME 2— DATA PLOTS) | | 5. FUNDING NUMBERS PE 62936N, 62232N | | |
| 6. AUTHOR(S) Patrick E. Gilles, Joseph R. Katan, and Robert J. Pellowski | | | | |
| 7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Undersea Warfare Center Division 1176 Howell Street Newport, RI 02841-1708 | | 8. PERFORMING ORGANIZATION REPORT NUMBER TR 11,106-2 | | |
| 9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Office of Naval Research ONR 313 800 North Quincy Street Arlington, VA 22217-5160 | | 10. SPONSORING/MONITORING AGENCY REPORT NUMBER National Science Foundation Office of Polar Programs 1800 G Street, NW Washington, DC 20660 | | |
| 11. SUPPLEMENTARY NOTES | | | | |
| 12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution is unlimited. | | | 12b. DISTRIBUTION CODE | |
| 13. ABSTRACT (Maximum 200 words) A high-frequency (HF)/automatic link establishment network was established between four sites located in Christchurch in New Zealand, Salisbury in Australia, and McMurdo and Davis Station in Antarctica. The experiment was a joint effort between the U.S. Naval Undersea Warfare Center and the Australian Defence Science and Technology Organisation. Hourly link quality analysis data were collected between September 1992 and November 1994. The primary goal was to study the potential benefits of introducing an automatic frequency management system into the daily operations of the HF communications links involving mid- to high-latitude propagation paths. Ten frequencies between 5 and 26 MHz were evaluated and the data were plotted versus time-of-day and season and compared to predicted results. This report is presented in two volumes. Volume 1 (TR 11,106-1) contains the background, site descriptions, equipment and experiment design information, and conclusions. Volume 2 (TR 11,106-2) contains the supporting data plots. | | | | |
| 14. SUBJECT TERMS Automatic link establishment network High-frequency communications | | | 15. NUMBER OF PAGES 150 | |
| | | | 16. PRICE CODE | |
| 17. SECURITY CLASSIFICATION OF REPORT Unclassified | 18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified | 19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified | 20. LIMITATION OF ABSTRACT SAR | |

LIST OF ILLUSTRATIONS

| Figure | | Page |
|--------|---|------|
| 1 | Circuit Availability by Season, Christchurch to Davis, 1993 and 1994..... | 2 |
| 2 | Circuit Availability by Season, Christchurch to McMurdo, 1993 and 1994..... | 3 |
| 3 | Circuit Availability by Season, Christchurch to Salisbury, 1993 and 1994..... | 4 |
| 4 | Circuit Availability by Season, Davis to Christchurch, 1993 and 1994..... | 5 |
| 5 | Circuit Availability by Season, Davis to McMurdo, 1993 and 1994..... | 6 |
| 6 | Circuit Availability by Season, Davis to Salisbury, 1993 and 1994..... | 7 |
| 7 | Circuit Availability by Season, Salisbury to Christchurch, 1993 and 1994..... | 8 |
| 8 | Circuit Availability by Season, Salisbury to Davis, 1993 and 1994..... | 9 |
| 9 | Circuit Availability by Season, Salisbury to McMurdo, 1993 and 1994..... | 10 |
| 10 | Link Availability and Circuit Availability by Season, Christchurch to Davis, 1993..... | 11 |
| 11 | Link Availability and Circuit Availability by Season, Christchurch to McMurdo, 1993..... | 11 |
| 12 | Link Availability and Circuit Availability by Season, Christchurch to McMurdo, 1994..... | 12 |
| 13 | Link Availability and Circuit Availability by Season, Christchurch to Salisbury, 1993..... | 12 |
| 14 | Link Availability and Circuit Availability by Season, Christchurch to Salisbury, 1994..... | 13 |
| 15 | Link Availability and Circuit Availability by Season, Davis to Christchurch, 1993..... | 13 |
| 16 | Link Availability and Circuit Availability by Season, Davis to McMurdo, 1993..... | 14 |
| 17 | Link Availability and Circuit Availability by Season, Davis to McMurdo, 1994..... | 14 |
| 18 | Link Availability and Circuit Availability by Season, Davis to Salisbury, 1993..... | 15 |
| 19 | Link Availability and Circuit Availability by Season, Davis to Salisbury, 1994..... | 15 |
| 20 | Link Availability and Circuit Availability by Season, Salisbury to Christchurch, 1993..... | 16 |
| 21 | Link Availability and Circuit Availability by Season, Salisbury to Christchurch, 1994..... | 16 |

LIST OF ILLUSTRATIONS (Cont'd)

| Figure | | Page |
|--------|--|------|
| 22 | Link Availability and Circuit Availability by Season, Salisbury to Davis, 1993 | 17 |
| 23 | Link Availability and Circuit Availability by Season, Salisbury to Davis, 1994 | 17 |
| 24 | Link Availability and Circuit Availability by Season, Salisbury to McMurdo, 1993 | 18 |
| 25 | Link Availability and Circuit Availability by Season, Salisbury to McMurdo, 1994 | 18 |
| 26 | Percent Availability and SNR by Frequency, Salisbury to McMurdo, Fall 1993 | 19 |
| 27 | Percent Availability and SNR by Frequency, Salisbury to McMurdo, Winter 1993 | 19 |
| 28 | Percent Availability and SNR by Frequency, Salisbury to McMurdo, Spring 1993 | 20 |
| 29 | Percent Availability and SNR by Frequency, Salisbury to McMurdo, Summer 1993 | 20 |
| 30 | Percent Availability and SNR by Frequency, Salisbury to McMurdo, Fall 1994 | 21 |
| 31 | Percent Availability and SNR by Frequency, Salisbury to McMurdo, Winter 1994 | 22 |
| 32 | Percent Availability and SNR by Frequency, Salisbury to McMurdo, Spring 1994 | 22 |
| 33 | Percent Availability and SNR by Frequency, Salisbury to Davis, Fall 1993 | 22 |
| 34 | Percent Availability and SNR by Frequency, Salisbury to Davis, Winter 1993 | 23 |
| 35 | Percent Availability and SNR by Frequency, Salisbury to Davis, Spring 1993 | 23 |
| 36 | Percent Availability and SNR by Frequency, Salisbury to Davis, Summer 1994 | 24 |
| 37 | Percent Availability and SNR by Frequency, Salisbury to Christchurch, Fall 1993 | 24 |
| 38 | Percent Availability and SNR by Frequency, Salisbury to Christchurch, Spring 1993 | 25 |

LIST OF ILLUSTRATIONS (Cont'd)

| Figure | | Page |
|--------|--|------|
| 39 | Percent Availability and SNR by Frequency, Salisbury to Christchurch, Summer 1994 | 25 |
| 40 | Percent Availability and SNR by Frequency, Salisbury to Christchurch, Winter 1994 | 26 |
| 41 | Percent Availability and SNR by Frequency, Salisbury to Christchurch, Spring 1994..... | 26 |
| 42 | Percent Availability and SNR by Frequency, Christchurch to Salisbury, Winter 1993 | 27 |
| 43 | Percent Availability and SNR by Frequency, Christchurch to Salisbury, Spring 1993..... | 27 |
| 44 | Percent Availability and SNR by Frequency, Christchurch to Salisbury, Winter 1994 | 28 |
| 45 | Percent Availability and SNR by Frequency, Christchurch to Salisbury, Spring 1994..... | 28 |
| 46 | Percent Availability and SNR by Frequency, Christchurch to McMurdo, Winter 1993 | 29 |
| 47 | Percent Availability and SNR by Frequency, Christchurch to McMurdo Spring 1993..... | 29 |
| 48 | Percent Availability and SNR by Frequency, Christchurch to McMurdo, Winter 1994 | 30 |
| 49 | Percent Availability and SNR by Frequency, Christchurch to Davis, Winter 1993 | 30 |
| 50 | Percent Availability and SNR by Frequency, Davis to Salisbury, Fall 1993 | 31 |
| 51 | Percent Availability and SNR by Frequency, Davis to Salisbury, Winter 1993 | 31 |
| 52 | Percent Availability and SNR by Frequency, Davis to Salisbury, Spring 1993 | 32 |
| 53 | Percent Availability and SNR by Frequency, Davis to Salisbury, Summer 1994..... | 32 |
| 54 | Percent Availability and SNR by Frequency, Davis to Christchurch, Winter 1993.. | 33 |
| 55 | Percent Availability and SNR by Frequency, Davis to Christchurch, Spring 1993 .. | 33 |
| 56 | Percent Availability and SNR by Frequency, Davis to McMurdo, Winter 1993 | 34 |
| 57 | Percent Availability and SNR by Frequency, Davis to McMurdo, Spring 1993 | 34 |
| 58 | Percent Availability and SNR by Frequency, Davis to McMurdo, Summer 1994.... | 35 |
| 59 | Number of Usable Frequencies at Each Link Attempt, Christchurch to Davis, 1993 | 35 |
| 60 | Number of Usable Frequencies at Each Link Attempt, Christchurch to McMurdo, 1993 | 36 |

LIST OF ILLUSTRATIONS (Cont'd)

| Figure | | Page |
|--------|---|------|
| 61 | Number of Usable Frequencies at Each Link Attempt, Christchurch to McMurdo, 1994 | 36 |
| 62 | Number of Usable Frequencies at Each Link Attempt, Christchurch to Salisbury, 1993 | 37 |
| 63 | Number of Usable Frequencies at Each Link Attempt, Christchurch to Salisbury, 1994 | 37 |
| 64 | Number of Usable Frequencies at Each Link Attempt, Davis to Christchurch, 1993 | 38 |
| 65 | Number of Usable Frequencies at Each Link Attempt, Davis to McMurdo, 1993 ... | 38 |
| 66 | Number of Usable Frequencies at Each Link Attempt, Davis to McMurdo, 1994 ... | 39 |
| 67 | Number of Usable Frequencies at Each Link Attempt, Davis to Salisbury, 1993 | 39 |
| 68 | Number of Usable Frequencies at Each Link Attempt, Davis to Salisbury, 1994 | 40 |
| 69 | Number of Usable Frequencies at Each Link Attempt, Salisbury to Christchurch, 1993 | 40 |
| 70 | Number of Usable Frequencies at Each Link Attempt, Salisbury to Christchurch, 1994 | 41 |
| 71 | Number of Usable Frequencies at Each Link Attempt, Salisbury to Davis, 1993 | 41 |
| 72 | Number of Usable Frequencies at Each Link Attempt, Salisbury to Davis, 1994 | 42 |
| 73 | Number of Usable Frequencies at Each Link Attempt, Salisbury to McMurdo, 1993 | 42 |
| 74 | Number of Usable Frequencies at Each Link Attempt, Salisbury to McMurdo, 1994 | 43 |
| 75 | Percent Availability of Each Frequency Group by Season, Christchurch to Davis | 44 |
| 76 | Percent Availability of Each Frequency Group by Season, Christchurch to McMurdo | 45 |
| 77 | Percent Availability of Each Frequency Group by Season, Christchurch to Salisbury | 46 |
| 78 | Percent Availability of Each Frequency Group by Season, Davis to Christchurch | 47 |
| 79 | Percent Availability of Each Frequency Group by Season, Davis to McMurdo | 48 |
| 80 | Percent Availability of Each Frequency Group by Season, Davis to Salisbury | 49 |

LIST OF ILLUSTRATIONS (Cont'd)

| Figure | | Page |
|--------|--|------|
| 81 | Percent Availability of Each Frequency Group by Season, Salisbury to Christchurch..... | 50 |
| 82 | Percent Availability of Each Frequency Group by Season, Salisbury to Davis..... | 51 |
| 83 | Percent Availability of each Frequency Group by Season, Salisbury to McMurdo | 52 |
| 84 | Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-Davis Link by Month, Winter 1993 (6-dB Minimum Measured SINAD) | 53 |
| 85 | Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-McMurdo Link by Month, Winter 1993 (6-dB Minimum Measured SINAD) | 53 |
| 86 | Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-McMurdo Link by Month, Spring 1993 (6-dB Minimum Measured SINAD)..... | 54 |
| 87 | Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-McMurdo Link by Month, Winter 1994 (6-dB Minimum Measured SINAD) | 54 |
| 88 | Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-Salisbury Link by Month, Winter 1993 (6-dB Minimum Measured SINAD) | 55 |
| 89 | Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-Salisbury Link by Month, Spring 1993 (6-dB Minimum Measured SINAD)..... | 55 |
| 90 | Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-Salisbury Link by Month, Winter 1994 (6-dB Minimum Measured SINAD) | 56 |
| 91 | Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-Salisbury Link by Month, Spring 1994 (6-dB Minimum Measured SINAD)..... | 56 |
| 92 | Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-Christchurch Link by Month, Winter 1993 (6-dB Minimum Measured SINAD) | 57 |
| 93 | Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-Christchurch Link by Month, Spring 1993 (6-dB Minimum Measured SINAD)..... | 57 |
| 94 | Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-Christchurch Link by Month, Summer/Winter 1993 (6-dB Minimum Measured SINAD)..... | 58 |
| 95 | Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-McMurdo Link by Month, Winter 1993 (6-dB Minimum Measured SINAD) | 58 |
| 96 | Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-McMurdo Link by Month, Spring 1993 (6-dB Minimum Measured SINAD)..... | 59 |
| 97 | Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-McMurdo Link by Month, Summer 1993/1994 (6-dB Minimum Measured SINAD)..... | 59 |

LIST OF ILLUSTRATIONS (Cont'd)

| Figure | | Page |
|--------|--|------|
| 98 | Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-Salisbury Link by Month, Summer 1992/1993 (6-dB Minimum Measured SINAD)..... | 60 |
| 99 | Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-Salisbury Link by Month, Fall 1993 (6-dB Minimum Measured SINAD)..... | 60 |
| 100 | Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-Salisbury Link by Month, Winter 1993 (6-dB Minimum Measured SINAD)..... | 61 |
| 101 | Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-Salisbury Link by Month, Spring 1993 (6-dB Minimum Measured SINAD)..... | 61 |
| 102 | Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-Salisbury Link by Month, Summer 1993/1994 (6-dB Minimum Measured SINAD)..... | 62 |
| 103 | Exceedance (90%, 50%, and 10%) for Best Frequency, McMurdo-to-Christchurch Link by Month, Spring 1993 (6-dB Minimum Measured SINAD)..... | 62 |
| 104 | Exceedance (90%, 50%, and 10%) for Best Frequency, McMurdo-to-Davis Link by Month, Summer 1992/1993 (6-dB Minimum Measured SINAD)..... | 63 |
| 105 | Exceedance (90%, 50%, and 10%) for Best Frequency, McMurdo-to-Davis Link by Month, Fall 1993 (6-dB Minimum Measured SINAD)..... | 63 |
| 106 | Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Christchurch Link by Month, Winter 1993 (6-dB Minimum Measured SINAD)..... | 64 |
| 107 | Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Christchurch Link by Month, Spring 1993 (6-dB Minimum Measured SINAD)..... | 64 |
| 108 | Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Christchurch Link by Month, Summer 1993/1994 (6-dB Minimum Measured SINAD)..... | 65 |
| 109 | Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Christchurch Link by Month, Winter 1994 (6-dB Minimum Measured SINAD)..... | 65 |
| 110 | Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Christchurch Link by Month, Spring 1994 (6-dB Minimum Measured SINAD)..... | 66 |
| 111 | Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Davis Link by Month, Summer 1992/1993 (6-dB Minimum Measured SINAD)..... | 66 |
| 112 | Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Davis Link by Month, Fall 1993 (6-dB Minimum Measured SINAD)..... | 67 |
| 113 | Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Davis Link by Month, Winter 1993 (6-dB Minimum Measured SINAD)..... | 67 |
| 114 | Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Davis Link by Month, Spring 1993 (6-dB Minimum Measured SINAD)..... | 68 |

LIST OF ILLUSTRATIONS (Cont'd)

| Figure | Page |
|---|------|
| 115 Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Davis Link by Month, Summer 1993/1994 (6-dB Minimum Measured SINAD)..... | 68 |
| 116 Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Month, Summer 1992/1993 (6-dB Minimum Measured SINAD)..... | 69 |
| 117 Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Month, Fall 1993 (6-dB Minimum Measured SINAD)..... | 69 |
| 118 Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Month, Winter 1993 (6-dB Minimum Measured SINAD) | 70 |
| 119 Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Month, Spring 1993 (6-dB Minimum Measured SINAD)..... | 70 |
| 120 Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Month, Summer 1993/1994 (6-dB Minimum Measured SINAD)..... | 71 |
| 121 Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Month, Fall 1994 (6-dB Minimum Measured SINAD)..... | 71 |
| 122 Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Month, Winter 1994 (6-dB Minimum Measured SINAD) | 72 |
| 123 Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Month, Spring 1994 (6-dB Minimum Measured SINAD)..... | 72 |
| 124 Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Month, Summer 1994/1995 (6-dB Minimum Measured SINAD)..... | 73 |
| 125 Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-Davis Link by Month, Winter 1993 (12-dB Minimum Measured SINAD) | 73 |
| 126 Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-McMurdo Link by Month, Winter 1993 (12-dB Minimum Measured SINAD) | 74 |
| 127 Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-McMurdo Link by Month, Spring 1993 (12-dB Minimum Measured SINAD)..... | 74 |
| 128 Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-Salisbury Link by Month, Winter 1993 (12-dB Minimum Measured SINAD) | 75 |
| 129 Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-Christchurch Link by Month, Summer 1993/1994 (12-dB Minimum Measured SINAD)..... | 75 |
| 130 Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-McMurdo Link by Month, Winter 1993 (12-dB Minimum Measured SINAD) | 76 |
| 131 Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-McMurdo Link by Month, Spring 1993 (12-dB Minimum Measured SINAD)..... | 76 |

LIST OF ILLUSTRATIONS (Cont'd)

| Figure | Page |
|---|------|
| 132 Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-McMurdo Link by Month, Summer 1993/1994 (12-dB Minimum Measured SINAD)..... | 77 |
| 133 Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-Salisbury Link by Month, Summer 1992/1993 (12-dB Minimum Measured SINAD)..... | 77 |
| 134 Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-Salisbury Link by Month, Spring 1993 (12-dB Minimum Measured SINAD)..... | 78 |
| 135 Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-Salisbury Link by Month, Summer 1993/1994 (12-dB Minimum Measured SINAD)..... | 78 |
| 136 Exceedance (90%, 50%, and 10%) for Best Frequency, McMurdo-to-Davis Link by Month, Summer 1992/1993 (12-dB Minimum Measured SINAD)..... | 79 |
| 137 Exceedance (90%, 50%, and 10%) for Best Frequency, McMurdo-to-Davis Link by Month, Fall 1993 (12-dB Minimum Measured SINAD)..... | 79 |
| 138 Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Christchurch Link by Month, Winter 1993 (12-dB Minimum Measured SINAD)..... | 80 |
| 139 Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Christchurch Link by Month, Spring 1993 (12-dB Minimum Measured SINAD)..... | 80 |
| 140 Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Christchurch Link by Month, Summer 1993/1994 (12-dB Minimum Measured SINAD)..... | 81 |
| 141 Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Christchurch Link by Month, Winter 1994 (12-dB Minimum Measured SINAD)..... | 81 |
| 142 Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Christchurch Link by Month, Spring 1994 (12-dB Minimum Measured SINAD)..... | 82 |
| 143 Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Davis Link by Month, Summer 1992/1993 (12-dB Minimum Measured SINAD)..... | 82 |
| 144 Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Davis Link by Month, Fall 1993 (12-dB Minimum Measured SINAD)..... | 83 |
| 145 Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Davis Link by Month, Winter 1993 (12-dB Minimum Measured SINAD)..... | 83 |
| 146 Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Davis Link by Month, Spring 1993 (6-dB Minimum Measured SINAD)..... | 84 |
| 147 Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Davis Link by Month, Summer 1993/1994 (12-dB Minimum Measured SINAD)..... | 84 |
| 148 Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Month, Summer 1992/1993 (12-dB Minimum Measured SINAD)..... | 85 |

LIST OF ILLUSTRATIONS (Cont'd)

| Figure | | Page |
|--------|--|------|
| 149 | Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Month, Fall 1993 (12-dB Minimum Measured SINAD)..... | 85 |
| 150 | Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Month, Winter 1993 (12-dB Minimum Measured SINAD)..... | 86 |
| 151 | Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Month, Spring 1993 (12-dB Minimum Measured SINAD)..... | 86 |
| 152 | Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Month, Summer 1993/1994 (12-dB Minimum Measured SINAD)..... | 87 |
| 153 | Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Month, Spring 1994 (12-dB Minimum Measured SINAD)..... | 87 |
| 154 | Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Month, Summer 1994/1995 (12-dB Minimum Measured SINAD)..... | 88 |
| 155 | Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-McMurdo Link by Month, Winter 1993 (18-dB Minimum Measured SINAD)..... | 88 |
| 156 | Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-McMurdo Link by Month, Spring 1993 (18-dB Minimum Measured SINAD)..... | 89 |
| 157 | Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-Salisbury Link by Month, Winter 1993 (18-dB Minimum Measured SINAD)..... | 89 |
| 158 | Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-McMurdo Link by Month, Winter 1993 (18-dB Minimum Measured SINAD)..... | 90 |
| 159 | Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-McMurdo Link by Month, Spring 1993 (18-dB Minimum Measured SINAD)..... | 90 |
| 160 | Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-McMurdo Link by Month, Summer 1993/1994 (18-dB Minimum Measured SINAD)..... | 91 |
| 161 | Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-Salisbury Link by Month, Spring 1993 (18-dB Minimum Measured SINAD)..... | 91 |
| 162 | Exceedance (90%, 50%, and 10%) for Best Frequency, McMurdo-to-Davis Link by Month, Fall 1993 (18-dB Minimum Measured SINAD)..... | 92 |
| 163 | Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Christchurch Link by Month, Spring 1993 (18-dB Minimum Measured SINAD)..... | 92 |
| 164 | Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Davis Link by Month, Summer 1992/1993 (18-dB Minimum Measured SINAD)..... | 93 |
| 165 | Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Davis Link by Month, Spring 1993 (18-dB Minimum Measured SINAD)..... | 93 |

LIST OF ILLUSTRATIONS (Cont'd)

| Figure | | Page |
|--------|--|------|
| 166 | Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Month, Summer 1992/1993 (18-dB Minimum Measured SINAD)..... | 94 |
| 167 | Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Month, Spring 1993 (18-dB Minimum Measured SINAD)..... | 94 |
| 168 | Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Month, Summer 1993/1994 (18-dB Minimum Measured SINAD)..... | 95 |
| 169 | Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Month, Spring 1994 (18-dB Minimum Measured SINAD)..... | 95 |
| 170 | Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-Davis Link by Season, 1993 (6-dB Minimum Measured SINAD) | 96 |
| 171 | Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-McMurdo Link by Season, 1993 (6-dB Minimum Measured SINAD) | 96 |
| 172 | Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-McMurdo Link by Season, 1994 (6-dB Minimum Measured SINAD) | 97 |
| 173 | Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-Salisbury Link by Season, 1993 (6-dB Minimum Measured SINAD) | 97 |
| 174 | Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-Salisbury Link by Season, 1994 (6-dB Minimum Measured SINAD) | 98 |
| 175 | Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-Christchurch Link by Season, 1993 (6-dB Minimum Measured SINAD) | 98 |
| 176 | Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-McMurdo Link by Season, 1993 (6-dB Minimum Measured SINAD) | 99 |
| 177 | Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-Salisbury Link by Season, 1992 (6-dB Minimum Measured SINAD) | 99 |
| 178 | Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-Salisbury Link by Season, 1993 (6-dB Minimum Measured SINAD) | 100 |
| 179 | Exceedance (90%, 50%, and 10%) for Best Frequency, McMurdo-to-Christchurch Link by Season, 1993 (6-dB Minimum Measured SINAD) | 100 |
| 180 | Exceedance (90%, 50%, and 10%) for Best Frequency, McMurdo-to-Davis Link by Season, 1992 (6-dB Minimum Measured SINAD) | 101 |
| 181 | Exceedance (90%, 50%, and 10%) for Best Frequency, McMurdo-to-Davis Link by Season, 1993 (6-dB Minimum Measured SINAD) | 101 |
| 182 | Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Christchurch Link by Season, 1993 (6-dB Minimum Measured SINAD) | 102 |

LIST OF ILLUSTRATIONS (Cont'd)

| Figure | | Page |
|--------|---|------|
| 183 | Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Christchurch Link by Season, 1994 (6-dB Minimum Measured SINAD) | 102 |
| 184 | Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Davis Link by Season, 1992 (6-dB Minimum Measured SINAD) | 103 |
| 185 | Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Davis Link by Season, 1993 (6-dB Minimum Measured SINAD) | 103 |
| 186 | Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Season, 1992 (6-dB Minimum Measured SINAD) | 104 |
| 187 | Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Season, 1993 (6-dB Minimum Measured SINAD) | 104 |
| 188 | Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Season, 1994 (6-dB Minimum Measured SINAD) | 105 |
| 189 | Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-Davis Link by Season, 1993 (12-dB Minimum Measured SINAD) | 105 |
| 190 | Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-McMurdo Link by Season, 1993 (12-dB Minimum Measured SINAD) | 106 |
| 191 | Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-Salisbury Link by Season, 1993 (12-dB Minimum Measured SINAD) | 106 |
| 192 | Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-Christchurch Link by Season, 1993 (12-dB Minimum Measured SINAD) | 107 |
| 193 | Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-McMurdo Link by Season, 1993 (12-dB Minimum Measured SINAD) | 107 |
| 194 | Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-Salisbury Link by Season, 1992 (12-dB Minimum Measured SINAD) | 108 |
| 195 | Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-Salisbury Link by Season, 1993 (12-dB Minimum Measured SINAD) | 108 |
| 196 | Exceedance (90%, 50%, and 10%) for Best Frequency, McMurdo-to-Davis Link by Season, 1992 (12-dB Minimum Measured SINAD) | 109 |
| 197 | Exceedance (90%, 50%, and 10%) for Best Frequency, McMurdo-to-Davis Link by Season, 1993 (12-dB Minimum Measured SINAD) | 109 |
| 198 | Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Christchurch Link by Season, 1993 (12-dB Minimum Measured SINAD) | 110 |
| 199 | Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Christchurch Link by Season, 1994 (12-dB Minimum Measured SINAD) | 110 |

LIST OF ILLUSTRATIONS (Cont'd)

| Figure | Page |
|---|------|
| 200 Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Davis Link by Season, 1992 (12-dB Minimum Measured SINAD) | 111 |
| 201 Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Davis Link by Season, 1993 (12-dB Minimum Measured SINAD) | 111 |
| 202 Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Season, 1992 (12-dB Minimum Measured SINAD) | 112 |
| 203 Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Season, 1993 (12-dB Minimum Measured SINAD) | 112 |
| 204 Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Season, 1994 (12-dB Minimum Measured SINAD) | 113 |
| 205 Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-McMurdo Link by Season, 1993 (18-dB Minimum Measured SINAD) | 113 |
| 206 Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-Salisbury Link by Season, 1993 (18-dB Minimum Measured SINAD) | 114 |
| 207 Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-Christchurch Link by Season, 1993 (18-dB Minimum Measured SINAD) | 114 |
| 208 Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-McMurdo Link by Season, 1993 (18-dB Minimum Measured SINAD) | 115 |
| 209 Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-Salisbury Link by Season, 1993 (18-dB Minimum Measured SINAD) | 115 |
| 210 Exceedance (90%, 50%, and 10%) for Best Frequency, McMurdo-to-Davis Link by Season, 1992 (18-dB Minimum Measured SINAD) | 116 |
| 211 Exceedance (90%, 50%, and 10%) for Best Frequency, McMurdo-to-Davis Link by Season, 1993 (18-dB Minimum Measured SINAD) | 116 |
| 212 Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Christchurch Link by Season, 1993 (18-dB Minimum Measured SINAD) | 117 |
| 213 Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Christchurch Link by Season, 1994 (18-dB Minimum Measured SINAD) | 117 |
| 214 Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Davis Link by Season, 1992 (12-dB Minimum Measured SINAD) | 118 |
| 215 Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Davis Link by Season, 1993 (18-dB Minimum Measured SINAD) | 118 |
| 216 Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Season, 1992 (18-dB Minimum Measured SINAD) | 119 |

LIST OF ILLUSTRATIONS (Cont'd)

| Figure | | Page |
|--------|--|------|
| 217 | Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Season, 1993 (18-dB Minimum Measured SINAD) | 119 |
| 218 | Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Season, 1994 (18-dB Minimum Measured SINAD) | 120 |
| 219 | Circuit Availability by Season, Christchurch to Davis, 1993-1994 | 121 |
| 220 | Circuit Availability by Season, Christchurch to McMurdo, 1993-1994 | 122 |
| 221 | Circuit Availability by Season, Christchurch to Salisbury, 1993-1994 | 123 |
| 222 | Circuit Availability by Season, Davis to Christchurch, 1993-1994 | 124 |
| 223 | Circuit Availability by Season, Davis to McMurdo, 1993-1994 | 125 |
| 224 | Circuit Availability by Season, Davis to Salisbury, 1993-1994 | 126 |
| 225 | Circuit Availability by Season, Salisbury to Christchurch, 1993-1994 | 127 |
| 226 | Circuit Availability by Season, Salisbury to McMurdo, 1993-1994 | 128 |
| 227 | Circuit Availability by Season, Salisbury to Davis, 1993-1994 | 129 |
| 228 | Link Symmetry for All Links, 1993-1994 | 130 |
| 229 | Link Symmetry, Salisbury to McMurdo, 0000-0400 UT | 130 |
| 230 | Link Symmetry, Salisbury to McMurdo, 0400-0800 UT | 131 |
| 231 | Link Symmetry, Salisbury to McMurdo, 0800-1200 UT | 131 |
| 232 | Link Symmetry, Salisbury to McMurdo, 1200-1600 UT | 132 |
| 233 | Link Symmetry, Salisbury to McMurdo, 1600-2000 UT | 132 |
| 234 | Link Symmetry, Salisbury to McMurdo, 2000-2400 UT | 133 |
| 235 | Link Symmetry, Salisbury to Christchurch, 0000-0400 UT | 133 |
| 236 | Link Symmetry, Salisbury to Christchurch, 0400-0800 UT | 134 |
| 237 | Link Symmetry, Salisbury to Christchurch, 0800-1200 UT | 134 |
| 238 | Link Symmetry, Salisbury to Christchurch, 1200-1600 UT | 135 |
| 239 | Link Symmetry, Salisbury to Christchurch, 1600-2000 UT | 135 |
| 240 | Link Symmetry, Salisbury to Christchurch, 2000-2400 UT | 136 |
| 241 | Link Symmetry, Davis to McMurdo, 0000-0400 UT | 136 |
| 242 | Link Symmetry, Davis to McMurdo, 0400-0800 UT | 137 |
| 243 | Link Symmetry, Davis to McMurdo, 0800-1200 UT | 137 |
| 244 | Link Symmetry, Davis to McMurdo, 1600-2000 UT | 138 |
| 245 | Link Symmetry, Davis to McMurdo, 2000-2400 UT | 138 |
| 246 | Link Symmetry, Salisbury to Davis, 0000-0400 UT | 139 |
| 247 | Link Symmetry, Salisbury to Davis, 0400-0800 UT | 139 |
| 248 | Link Symmetry, Salisbury to Davis, 0800-1200 UT | 140 |

LIST OF ILLUSTRATIONS (Cont'd)

| Figure | | Page |
|--------|---|------|
| 249 | Link Symmetry, Salisbury to Davis, 1200-1600 UT | 140 |
| 250 | Link Symmetry, Salisbury to Davis, 1600-2000 UT | 141 |
| 251 | Link Symmetry, Salisbury to Davis, 2000-2400 UT | 141 |
| 252 | Received SINAD vs. Channel Score | 142 |
| 253 | Measured SINAD vs. Channel Score | 142 |

**SEASONAL PERFORMANCE OF A HIGH-FREQUENCY/AUTOMATIC
LINK ESTABLISHMENT (HF/ALE) RADIO NETWORK
OPERATING AT MID TO HIGH LATITUDES IN
THE SOUTHERN HEMISPHERE
(VOLUME 2—DATA PLOTS)**

INTRODUCTION

A high-frequency/automatic link establishment (HF/ALE) network was set up between four sites located in Christchurch in New Zealand, Salisbury in Australia, and McMurdo and Davis Station in Antarctica. The primary goal was to study the potential benefits of introducing an automatic frequency management system into the daily operations of the HF communications links involving mid- to high-latitude propagation paths. Ten frequencies between 5 and 26 MHz were evaluated and the data were plotted versus time-of-day, season, and predicted results.

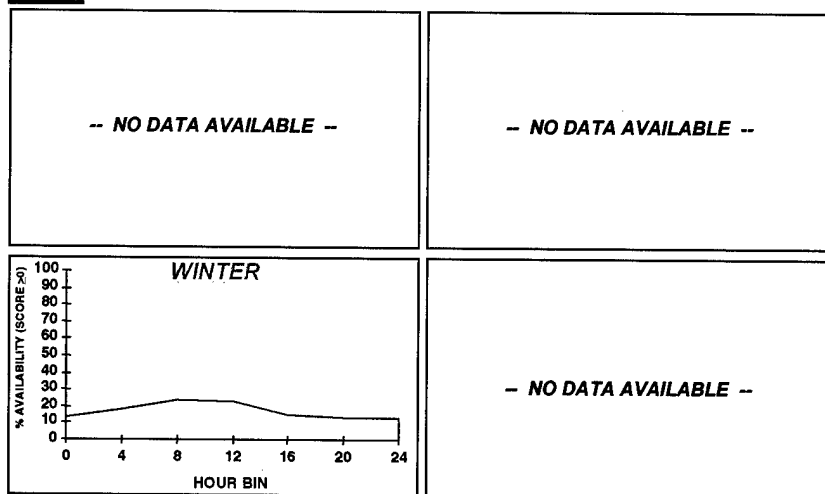
This volume (Volume 2) contains the complete set of data plots generated during the quality analysis phase of the operation (figures 1 through 253). Volume 1 (TR 11,106-1) contains the background, site descriptions, equipment and experiment design information, and conclusions. (Table 1 presents a summarization of the data plots as referenced to volume 1.)

Table 1. List of Data Plots and Referenced Volume I Material

| Reference to Section of Vol. 1 | Analysis or Comparison | Figure No. |
|---|---|-----------------------|
| 9.2.1 | Percent channel availability by season | 1-9 |
| 9.2.2 | Percent channel and link availability by season | 10-25 |
| 9.2.3 | Percent channel availability and SNR by season | 26-58 |
| 9.2.4 | Number of usable frequencies for each link attempt | 59-74 |
| 9.2.5 | Percent channel availability of frequency group by season | 75-83 |
| 9.2.6 | Highest observed frequency with SNR \geq 6 dB by month | 84-124 |
| 9.2.6 | Highest observed frequency with SNR \geq 12 dB by month | 125-152 |
| 9.2.6 | Highest observed frequency with SNR \geq 18 dB by month | 155-169 |
| 9.2.7 | Highest observed frequency with SNR \geq 6 dB by season | 170-188 |
| 9.2.7 | Highest observed frequency with SNR \geq 12 dB by season | 189-204 |
| 9.2.7 | Highest observed frequency with SNR \geq 18 dB by season | 205-218 |
| 9.2.8 | Seasonal link availability grouped by frequency band | 219-227 |
| 9.2.10 | Link symmetry (measured vs. received. SINAD) for all links | 228 |
| 9.2.10 | Link symmetry (measured vs. received. SINAD) for all links for 4-hour time bins | 229-251 |
| 9.2.11 | SINAD vs. channel score | 252-253 |

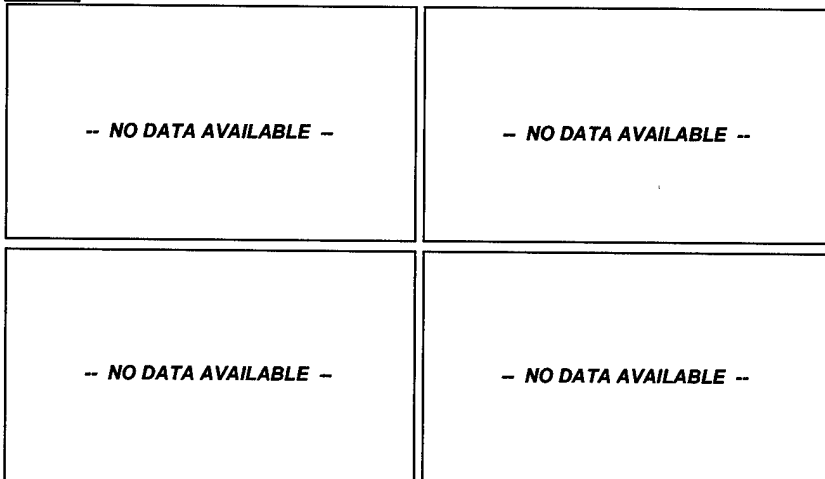
CHRISTCHURCH TO DAVIS

1993



☐ % CHANNEL AVAILABILITY

1994

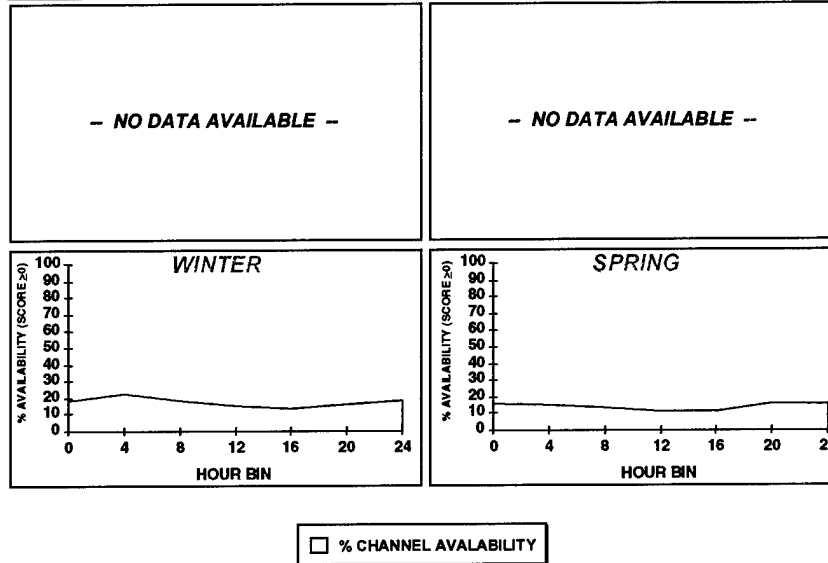


N1810-GA-95(L)0524U.M66A

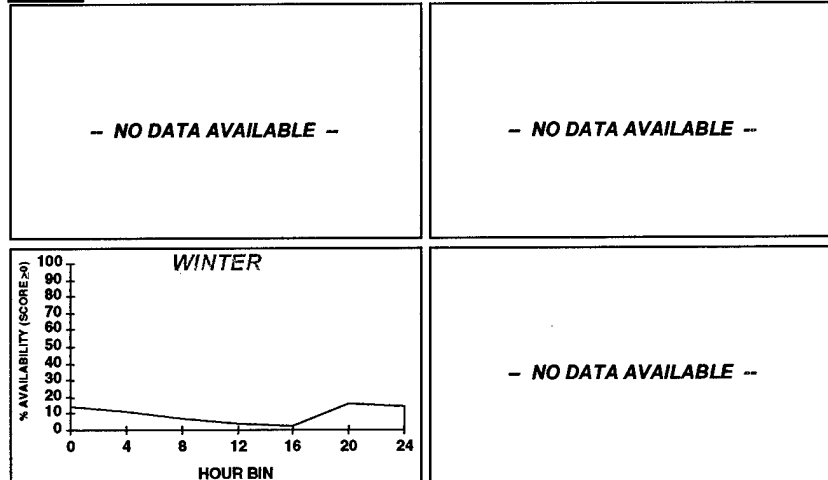
Figure 1. Circuit Availability by Season, Christchurch to Davis, 1993 and 1994

CHRISTCHURCH TO MCMURDO

1993



1994

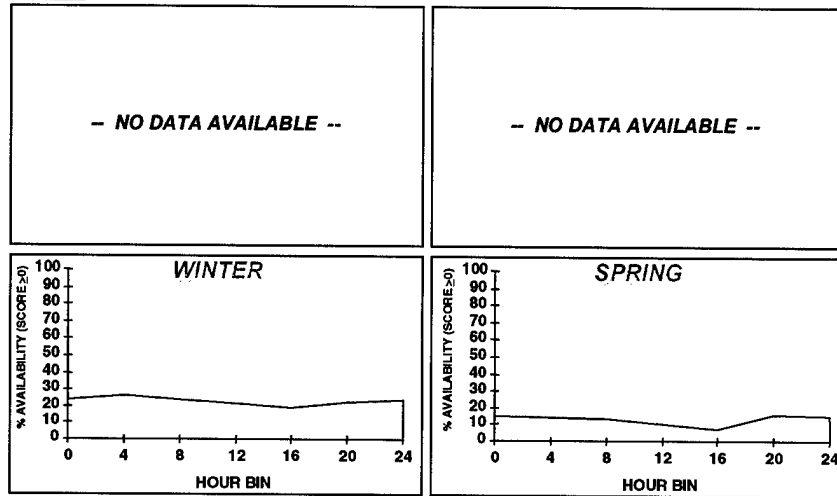


N1810-GA-95(L)0524U.M67A

Figure 2. Circuit Availability by Season, Christchurch to McMurdo, 1993 and 1994

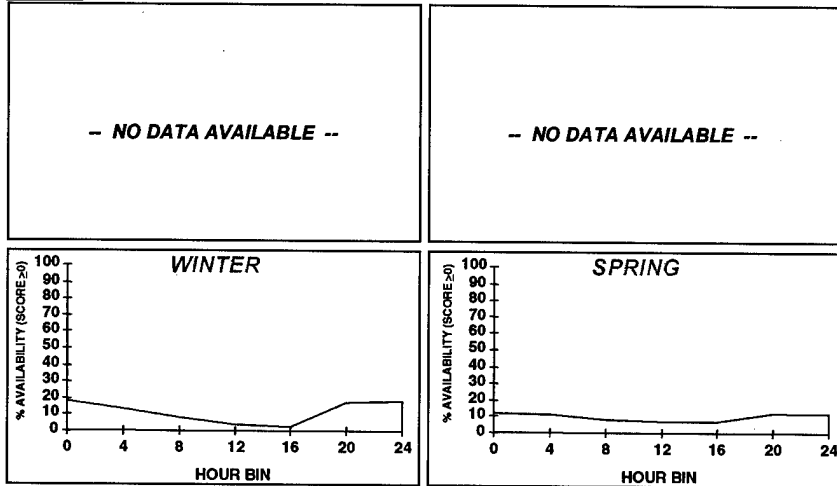
CHRISTCHURCH TO SALISBURY

1993



□ % CHANNEL AVAILABILITY

1994

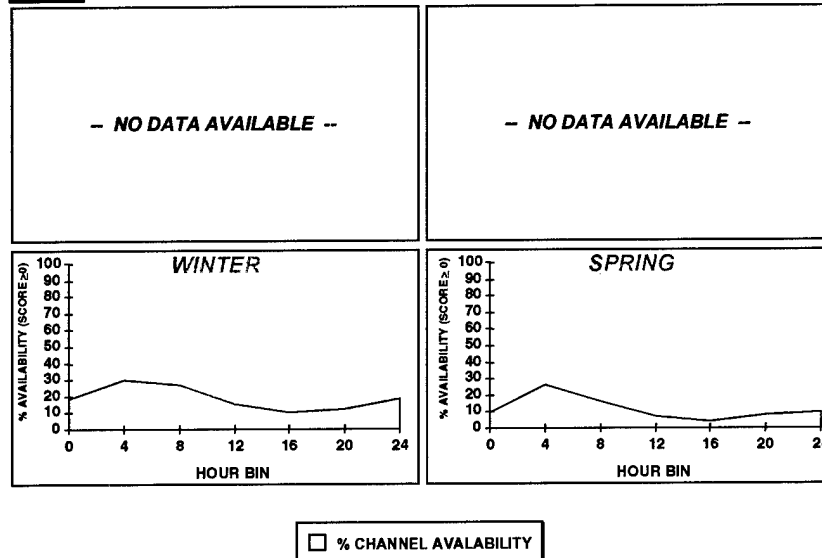


N1810-GA-95(L)0524U.M68A

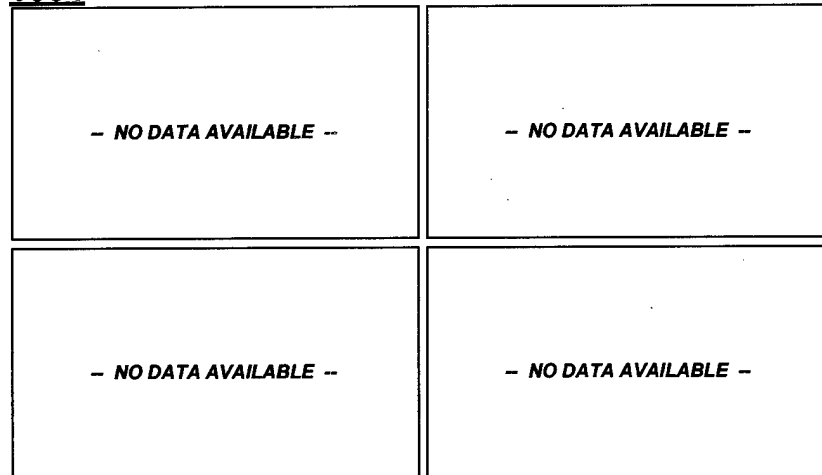
Figure 3. Circuit Availability by Season, Christchurch to Salisbury, 1993 and 1994

DAVIS TO CHRISTCHURCH

1993



1994

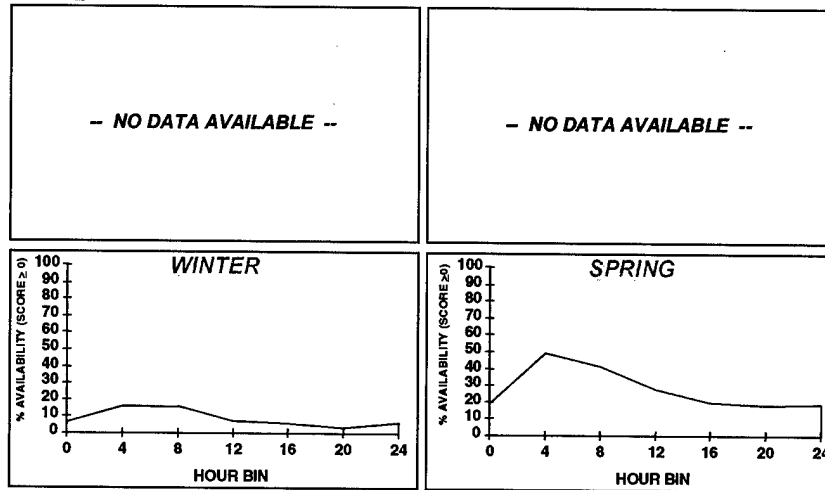


N1810-GA-95(L)0524U.M69A

Figure 4. Circuit Availability by Season, Davis to Christchurch, 1993 and 1994

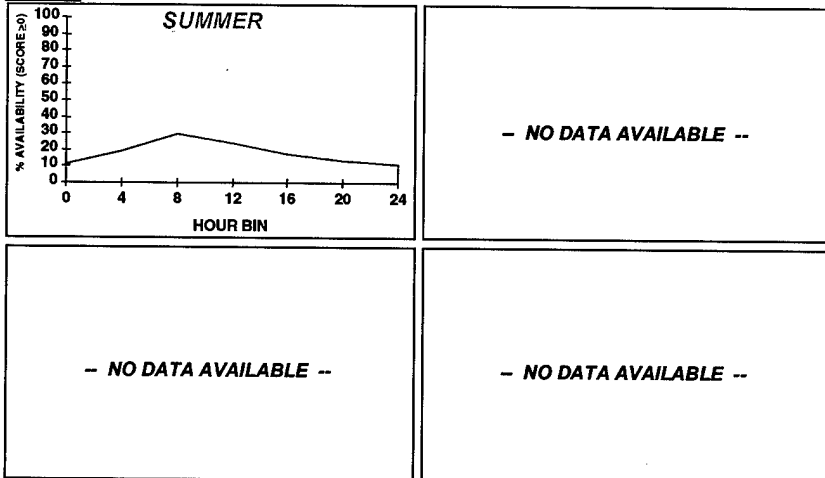
DAVIS TO MCMURDO

1993



□ % CHANNEL AVAILABILITY

1994



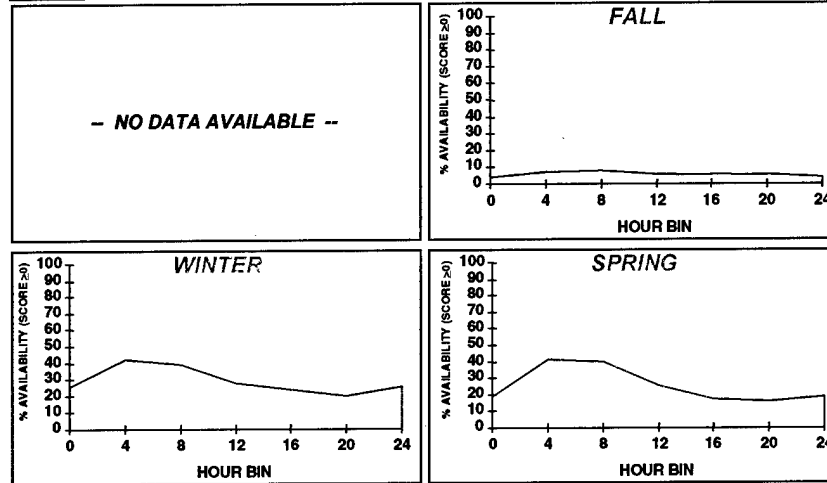
N1810-GA-95(L)0524U.M70A

N1810-GA-95(L)0524U.M70A

Figure 5. Circuit Availability by Season, Davis to McMurdo, 1993 and 1994

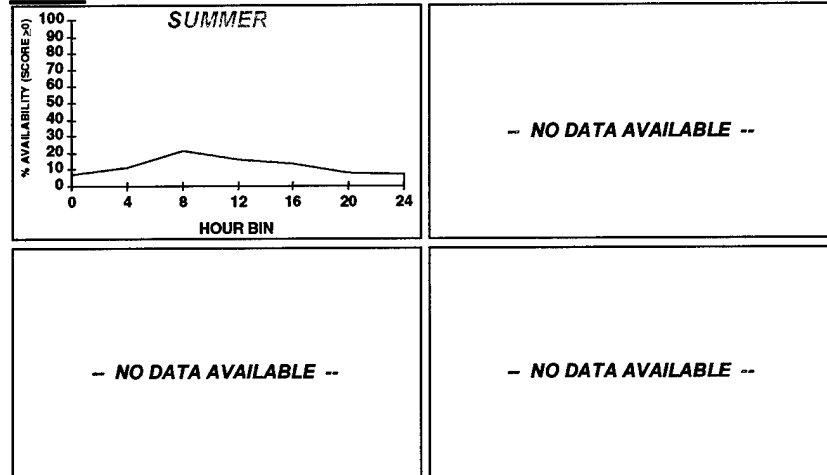
DAVIS TO SALISBURY

1993



□ % CHANNEL AVAILABILITY

1994



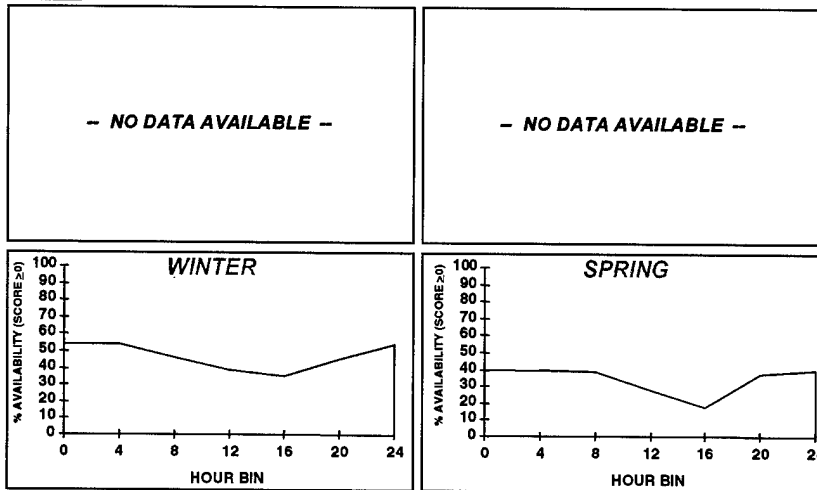
N1810-GA-95(L)0524U.M71A

N1810-GA-95(L)0524U.M71A

Figure 6. Circuit Availability by Season, Davis to Salisbury, 1993 and 1994

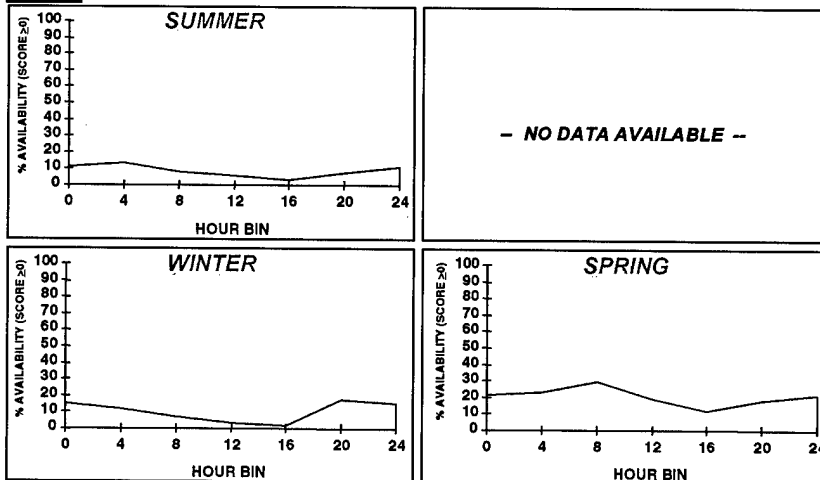
SALISBURY TO CHRISTCHURCH

1993



☐ % CHANNEL AVAILABILITY

1994

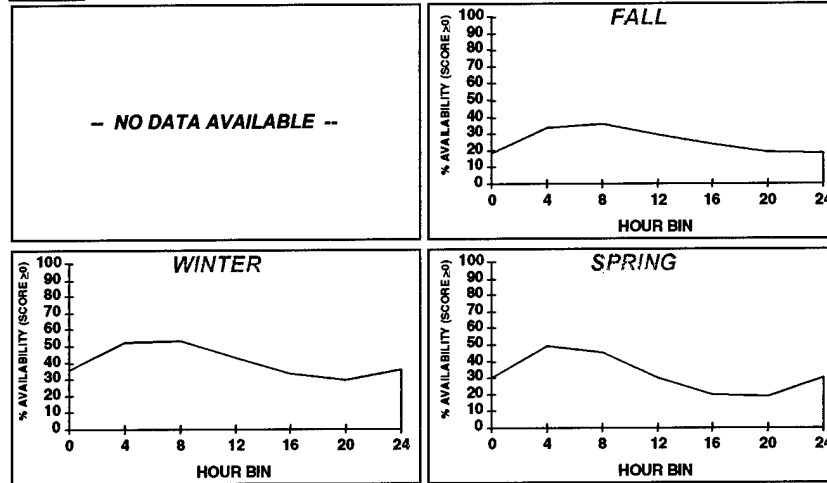


N1810-GA-95(L)0524U.M72A

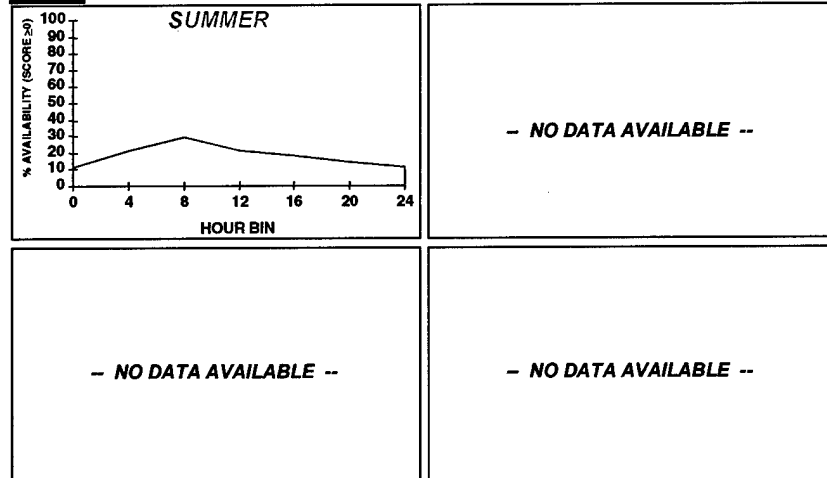
Figure 7. Circuit Availability by Season, Salisbury to Christchurch, 1993 and 1994

SALISBURY TO DAVIS

1993



1994



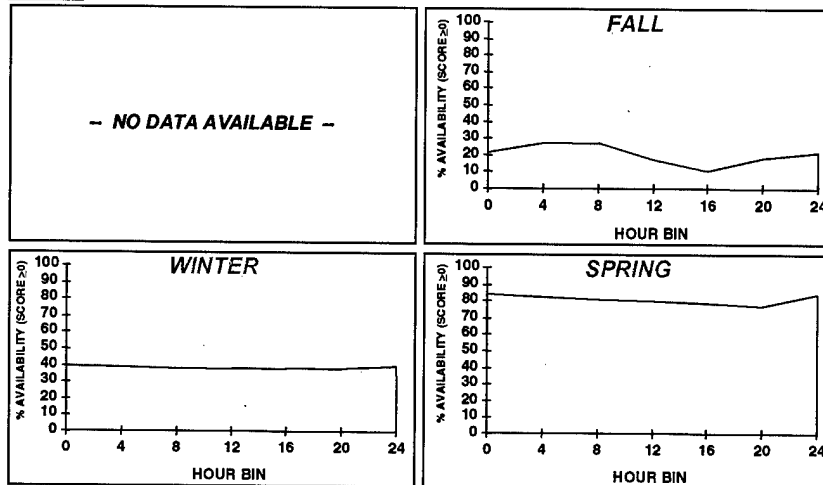
N1810-GA-95(L)0524U.M73A

N1810-GA-95(L)0524U.M73A

Figure 8. Circuit Availability by Season, Salisbury to Davis, 1993 and 1994

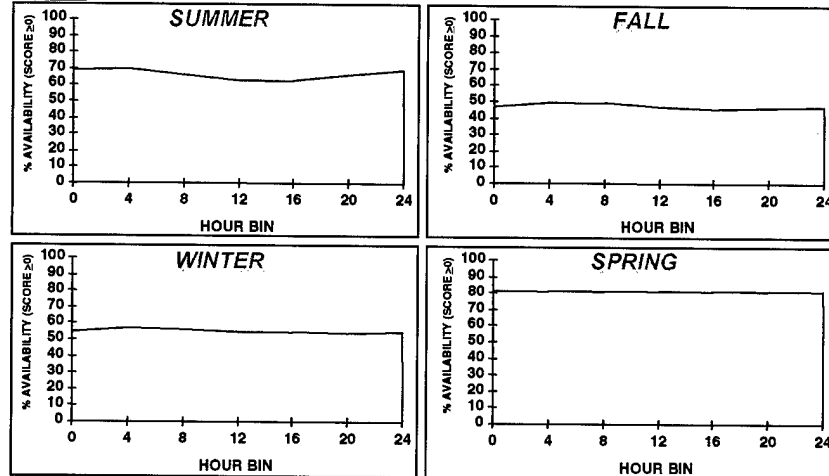
SALISBURY TO MCMURDO

1993



□ % CHANNEL AVAILABILITY

1994



N1810-GA-95(L)0524U.M74A

Figure 9. Circuit Availability by Season, Salisbury to McMurdo, 1993 and 1994

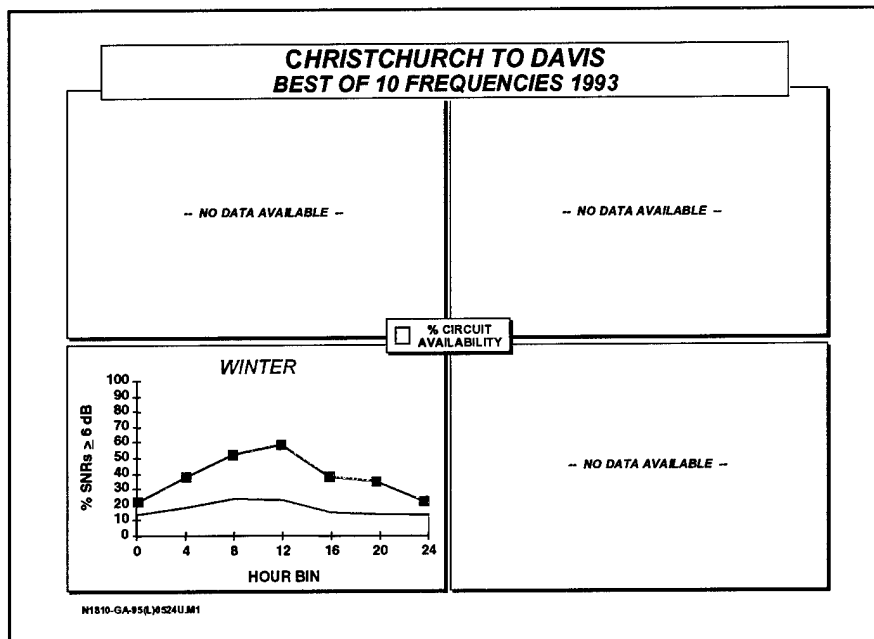


Figure 10. Link Availability and Circuit Availability by Season, Christchurch to Davis, 1993

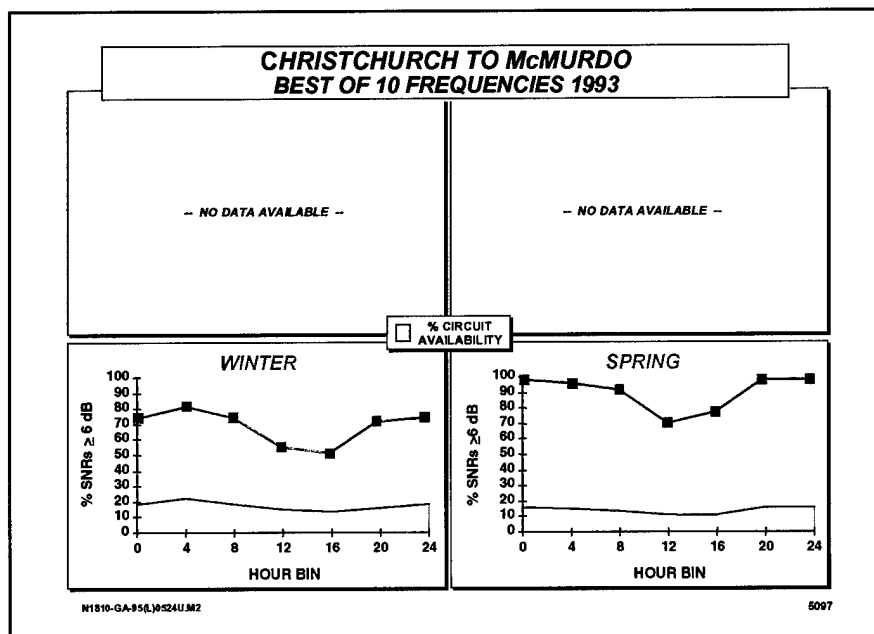
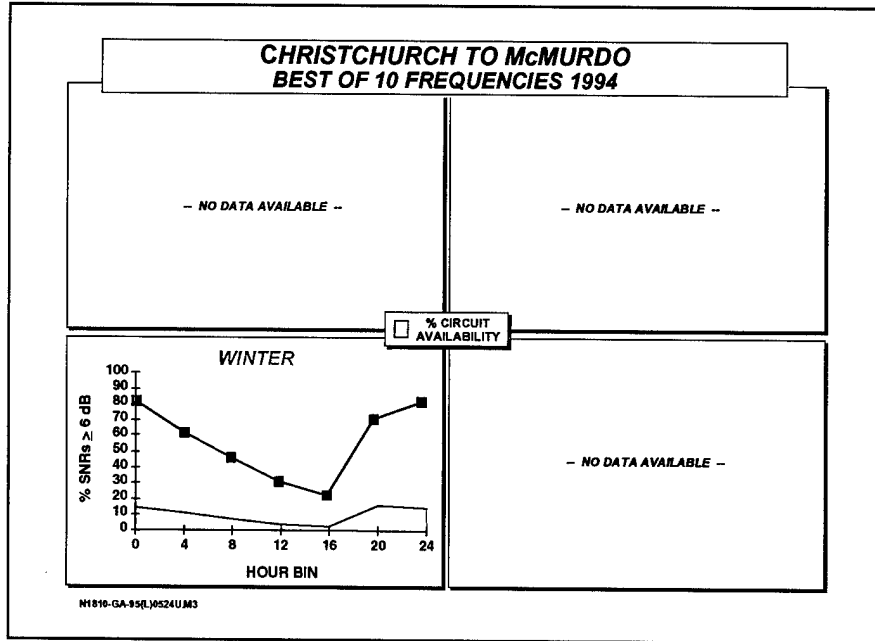
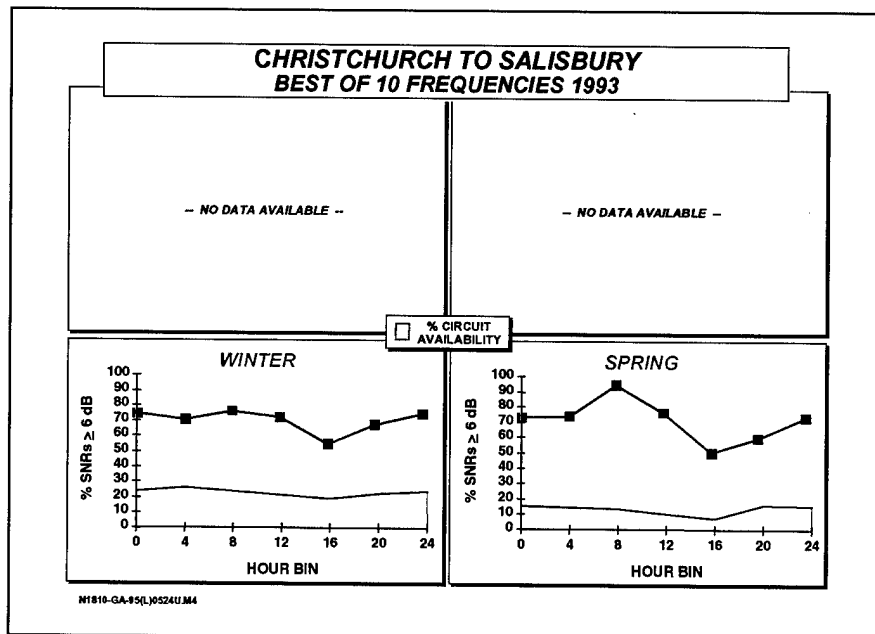


Figure 11. Link Availability and Circuit Availability by Season, Christchurch to McMurdo, 1993



**Figure 12. Link Availability and Circuit Availability by Season,
Christchurch to McMurdo, 1994**



**Figure 13. Link Availability and Circuit Availability by Season,
Christchurch to Salisbury, 1993**

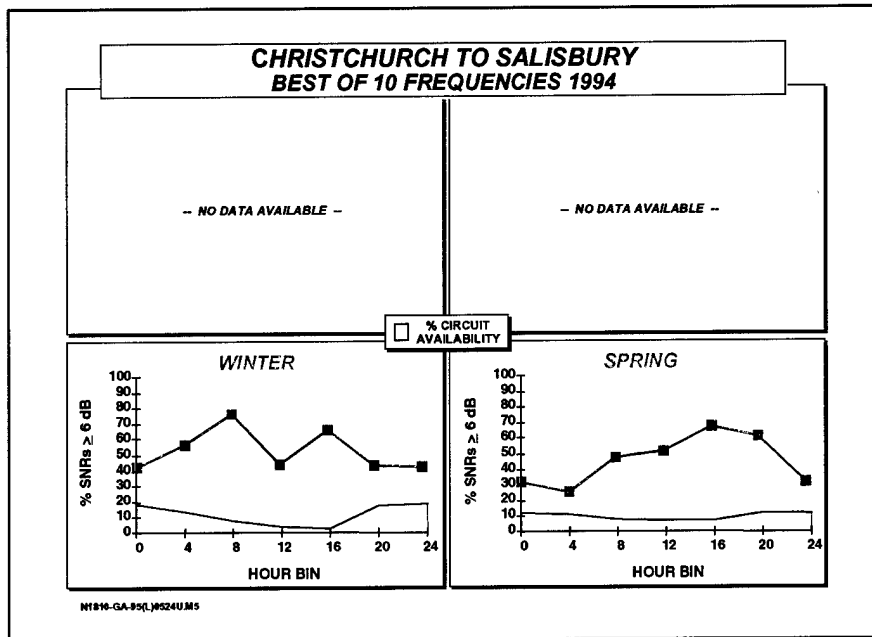


Figure 14. Link Availability and Circuit Availability by Season, Christchurch to Salisbury, 1994

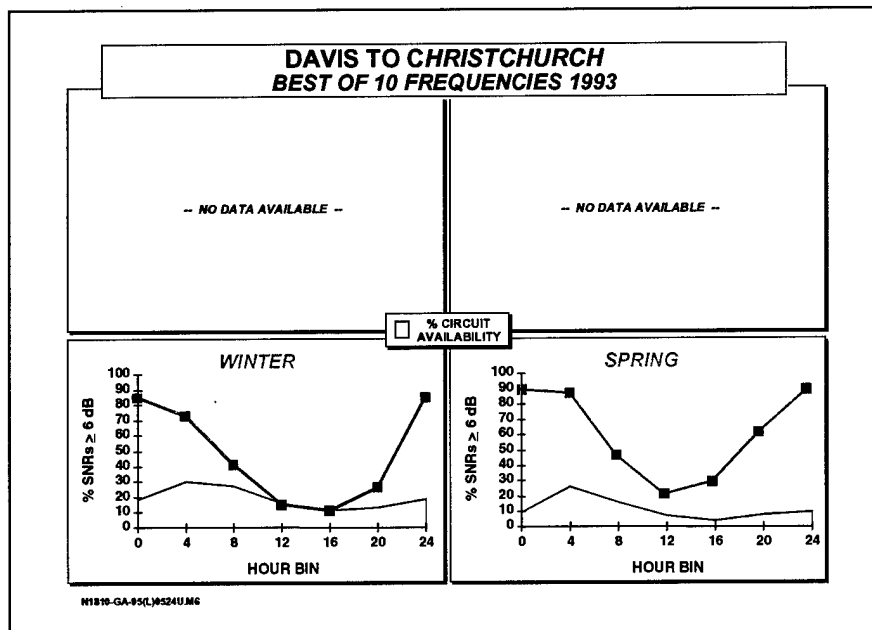
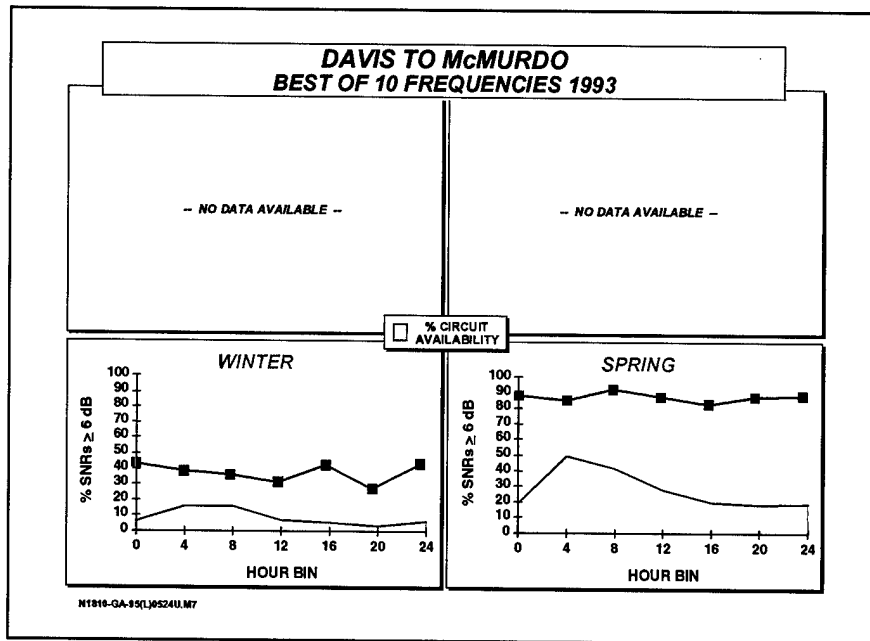
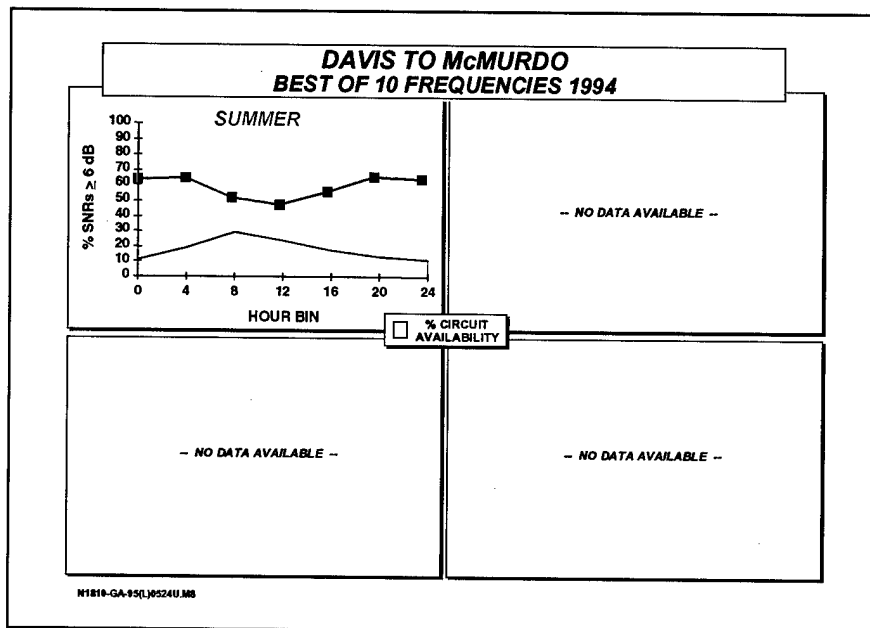


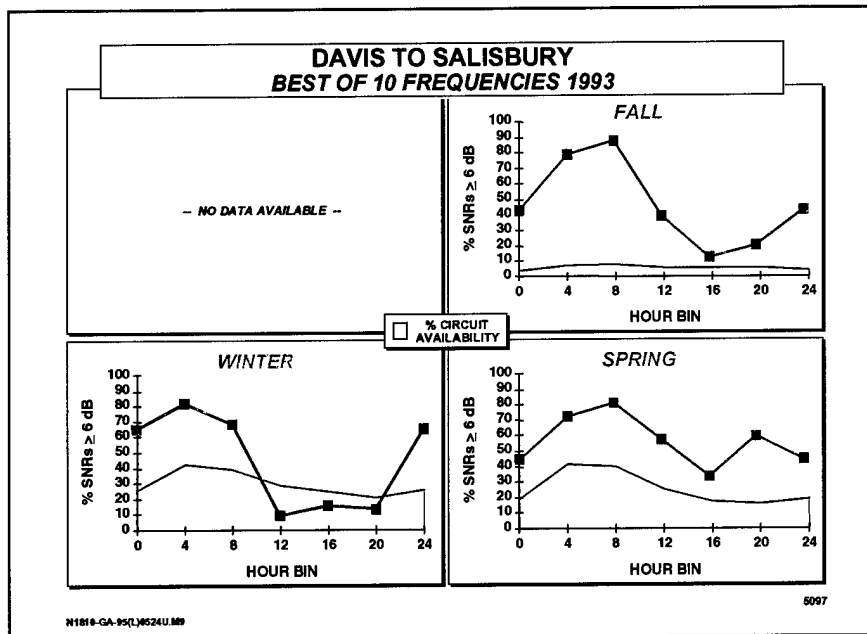
Figure 15. Link Availability and Circuit Availability by Season, Davis to Christchurch, 1993



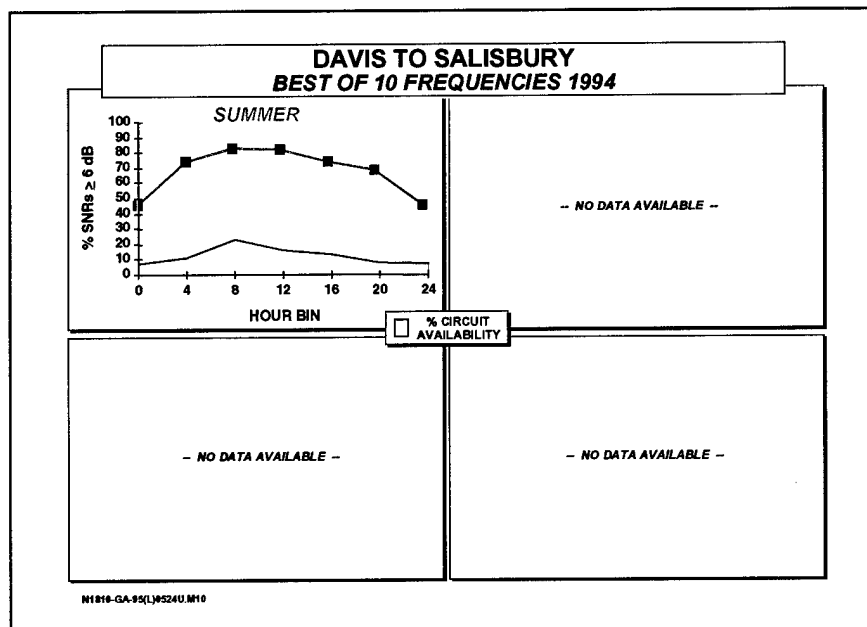
*Figure 16. Link Availability and Circuit Availability by Season,
Davis to McMurdo, 1993*



*Figure 17. Link Availability and Circuit Availability by Season,
Davis to McMurdo, 1994*



**Figure 18. Link Availability and Circuit Availability by Season,
Davis to Salisbury, 1993**



**Figure 19. Link Availability and Circuit Availability by Season,
Davis to Salisbury, 1994**

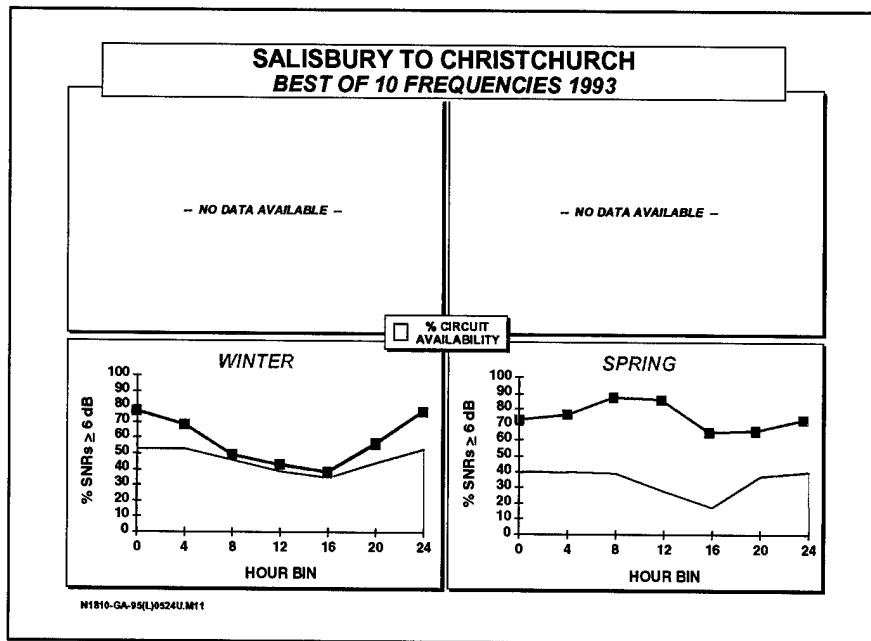


Figure 20. Link Availability and Circuit Availability by Season, Salisbury to Christchurch, 1993

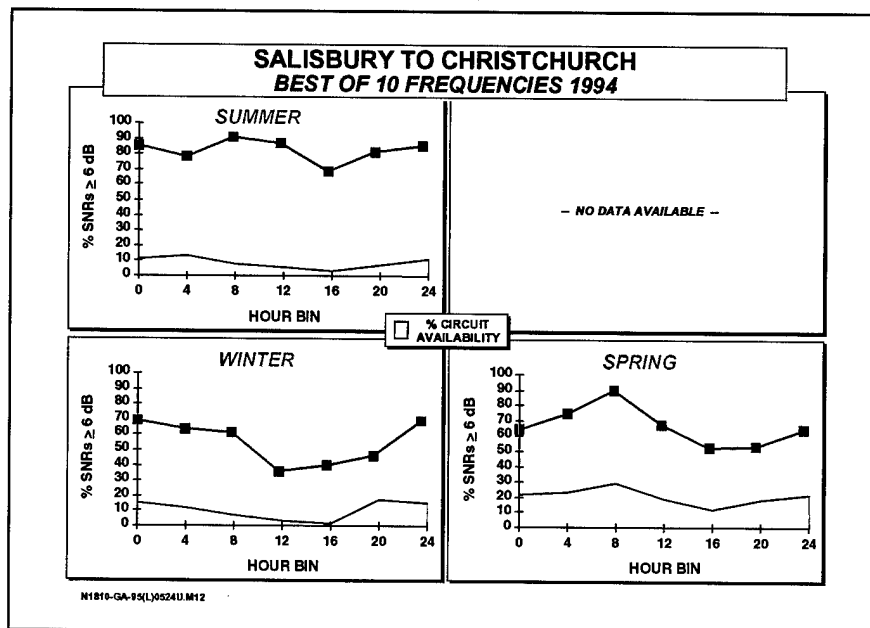


Figure 21. Link Availability and Circuit Availability by Season, Salisbury to Christchurch, 1994

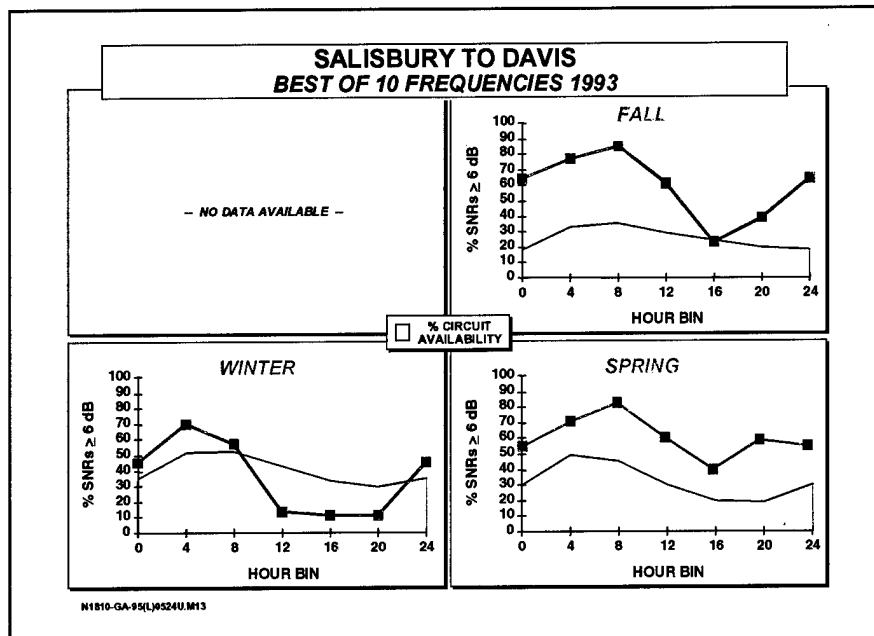


Figure 22. Link Availability and Circuit Availability by Season, Salisbury to Davis, 1993

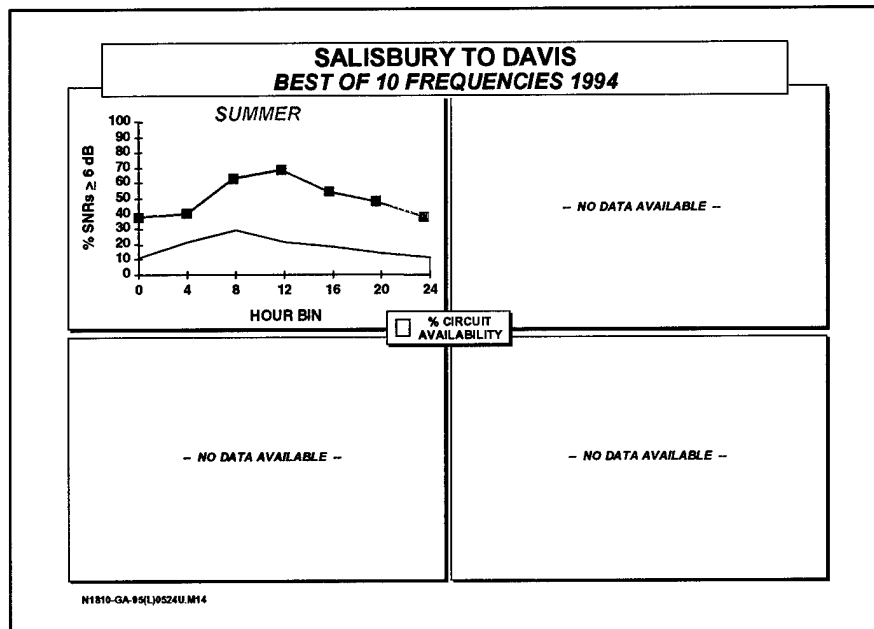
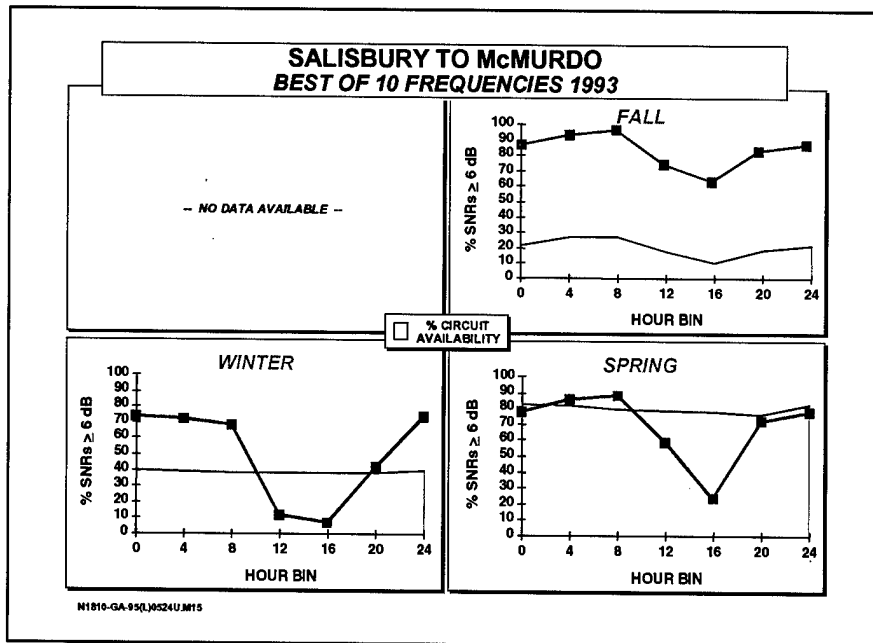
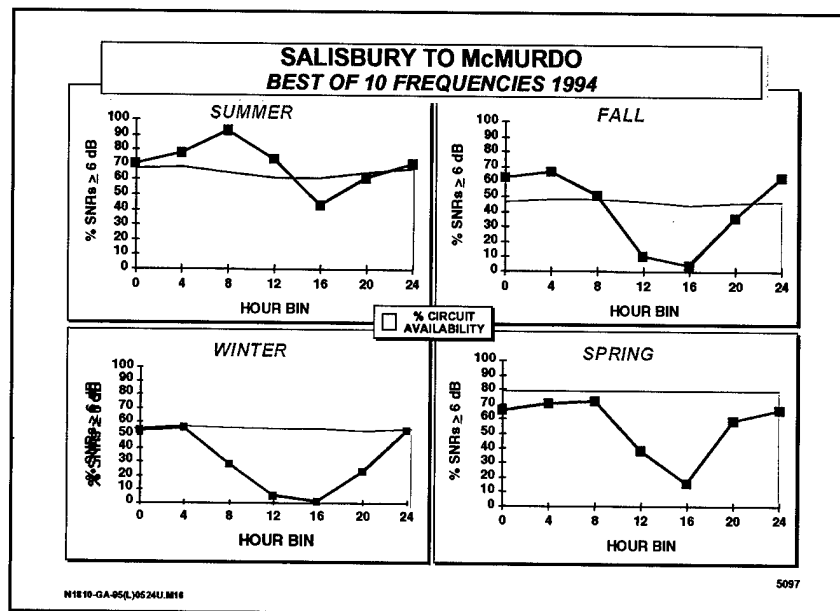


Figure 23. Link Availability and Circuit Availability by Season, Salisbury to Davis, 1994



**Figure 24. Link Availability and Circuit Availability by Season,
Salisbury to McMurdo, 1993**



**Figure 25. Link Availability and Circuit Availability by Season,
Salisbury to McMurdo, 1994**

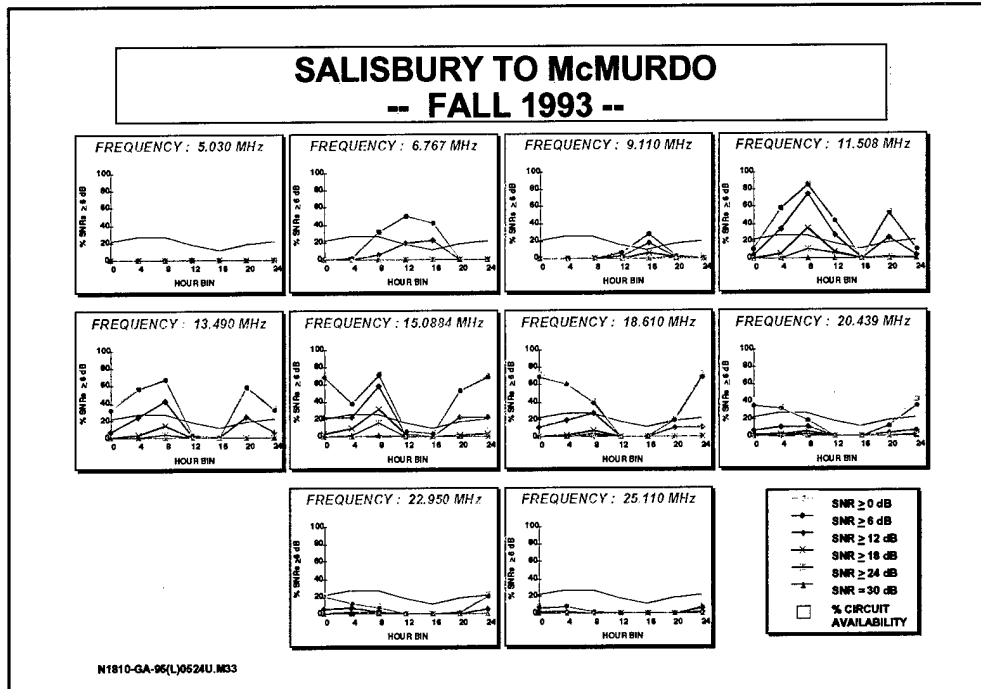


Figure 26. Percent Availability and SNR by Frequency, Salisbury to McMurdo, Fall 1993

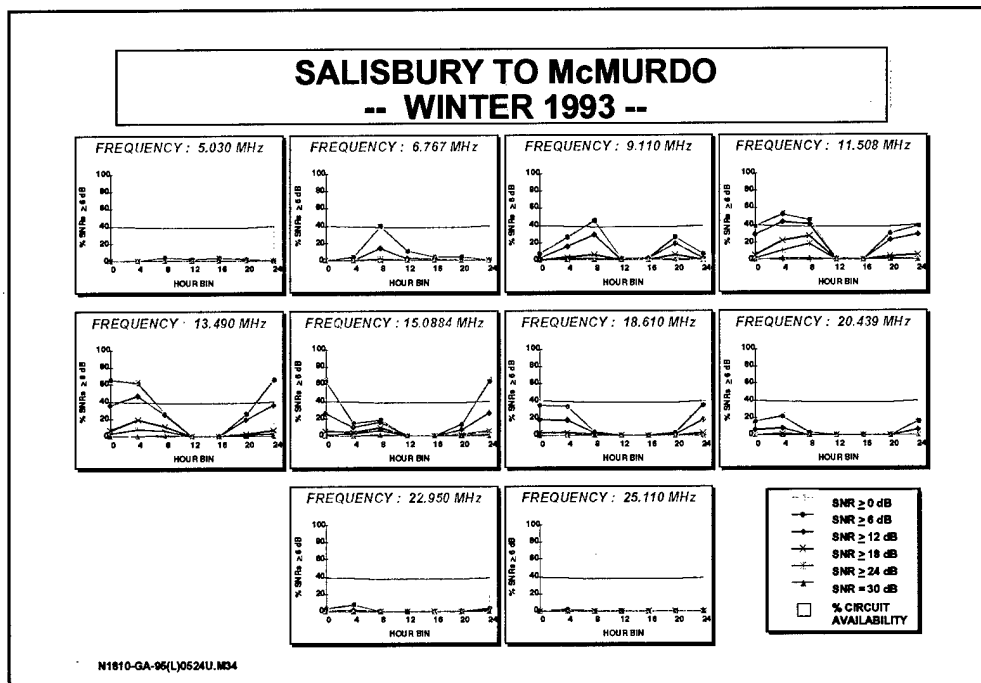


Figure 27. Percent Availability and SNR by Frequency, Salisbury to McMurdo, Winter 1993

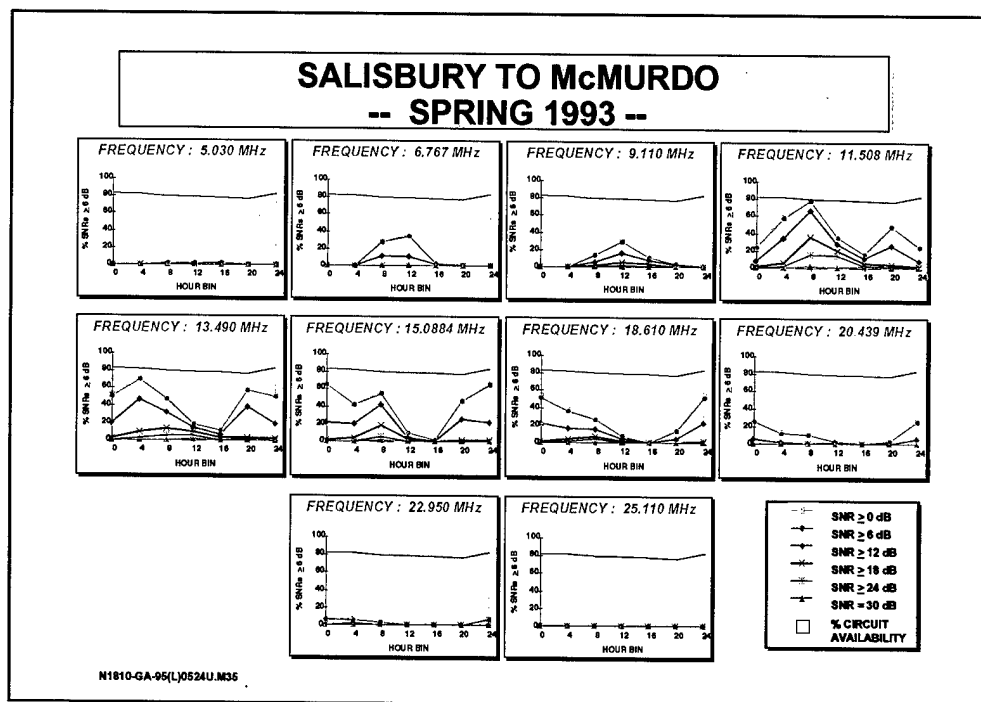


Figure 28. Percent Availability and SNR by Frequency, Salisbury to McMurdo, Spring 1993

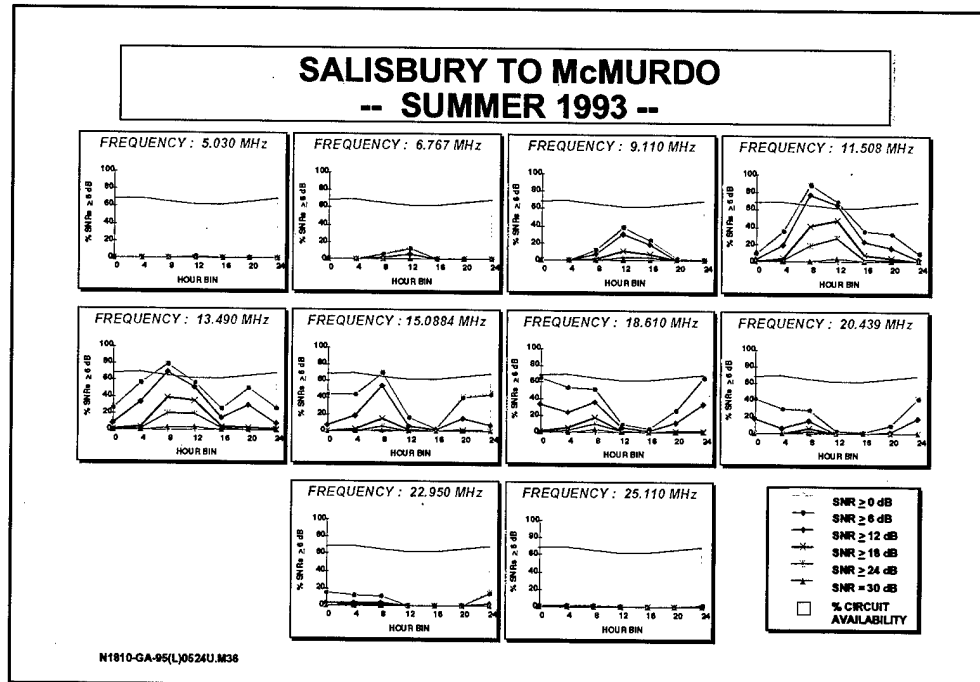


Figure 29. Percent Availability and SNR by Frequency, Salisbury to McMurdo, Summer 1993

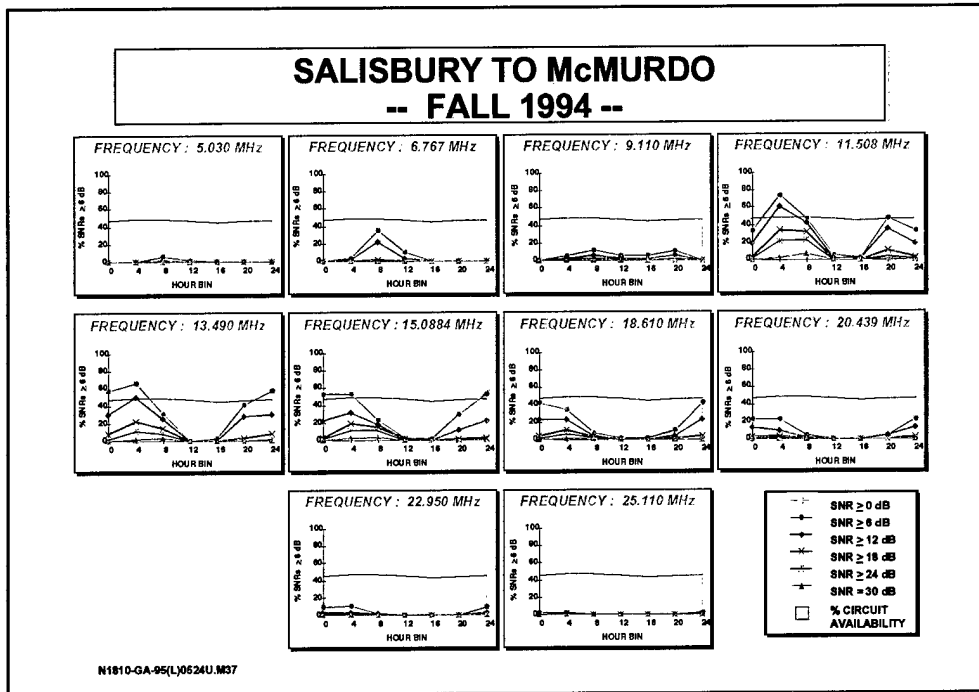


Figure 30. Percent Availability and SNR by Frequency, Salisbury to McMurdo, Fall 1994

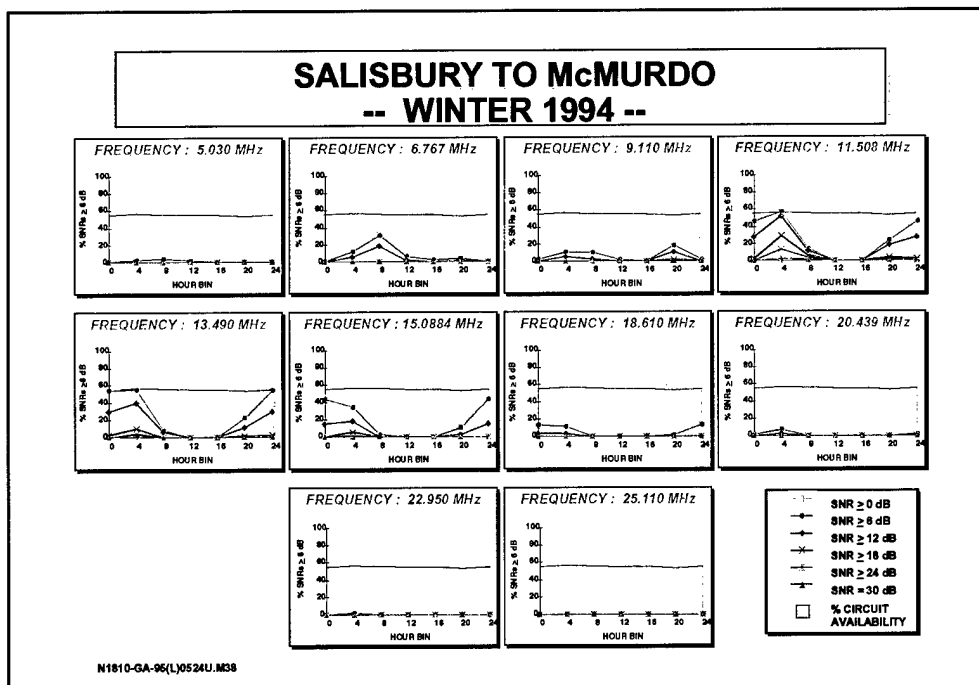


Figure 31. Percent Availability and SNR by Frequency, Salisbury to McMurdo, Winter 1994

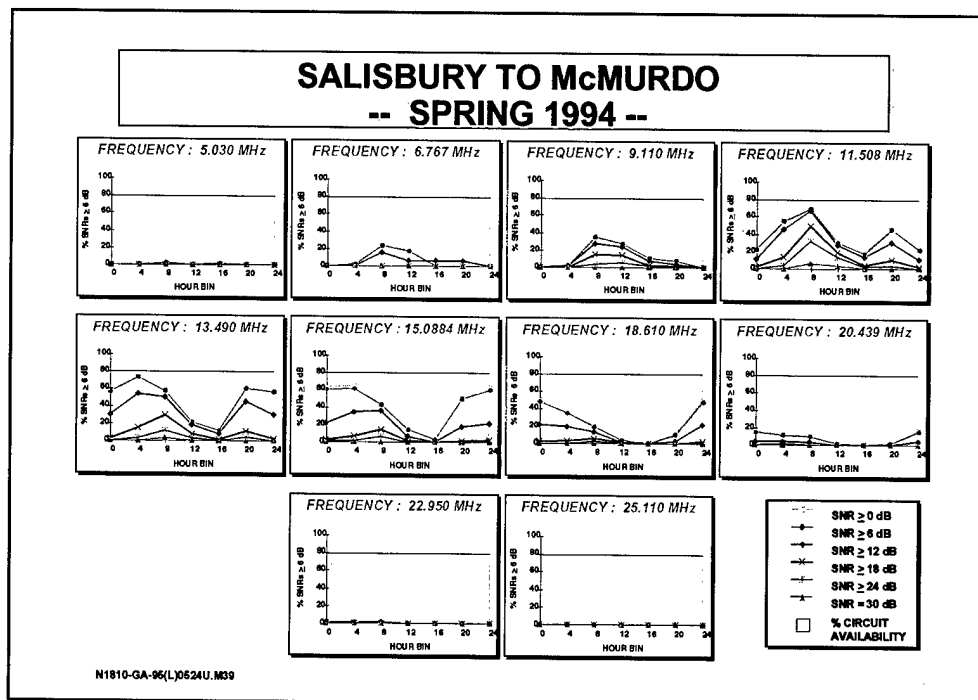


Figure 32. Percent Availability and SNR by Frequency, Salisbury to McMurdo, Spring 1994

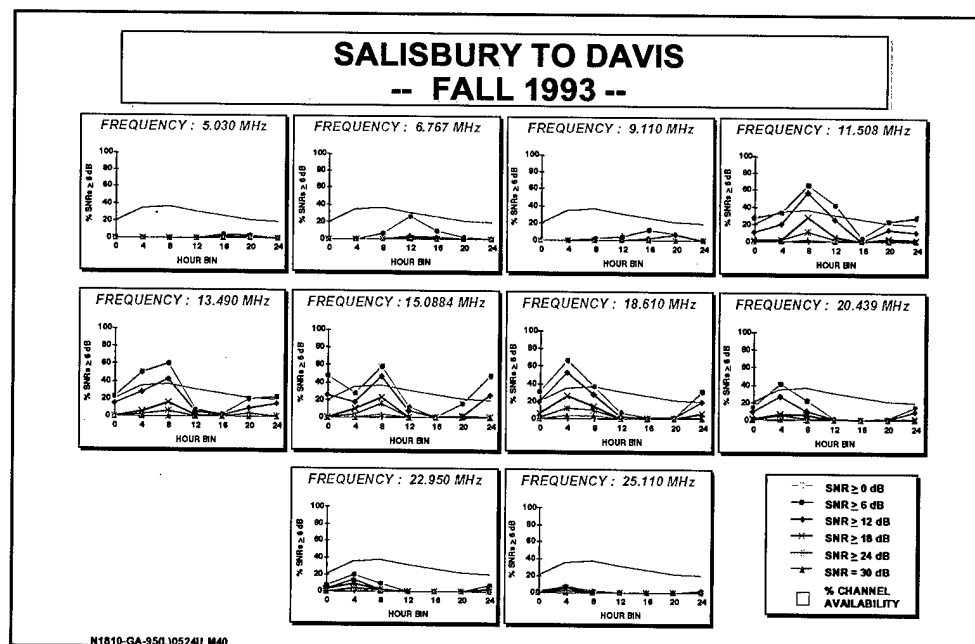


Figure 33. Percent Availability and SNR by Frequency, Salisbury to Davis, Fall 1993

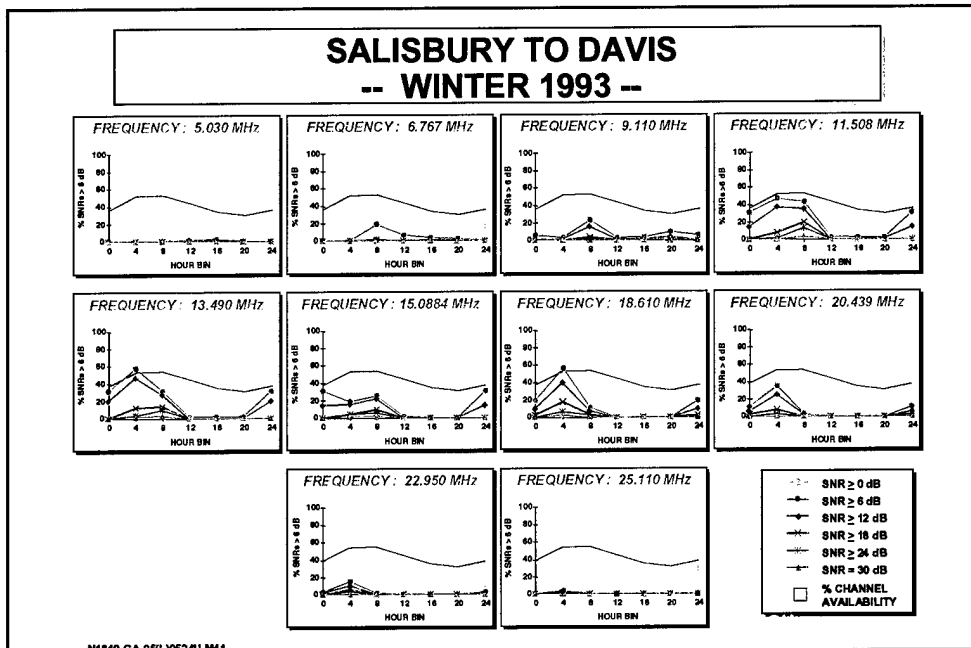


Figure 34. Percent Availability and SNR by Frequency, Salisbury to Davis, Winter 1993

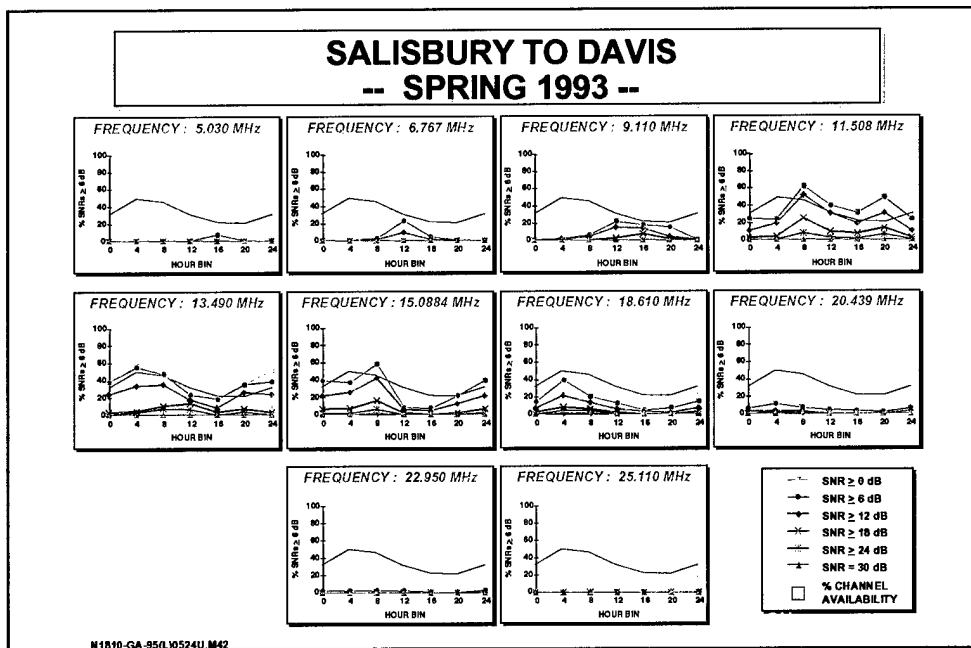


Figure 35. Percent Availability and SNR by Frequency, Salisbury to Davis, Spring 1993

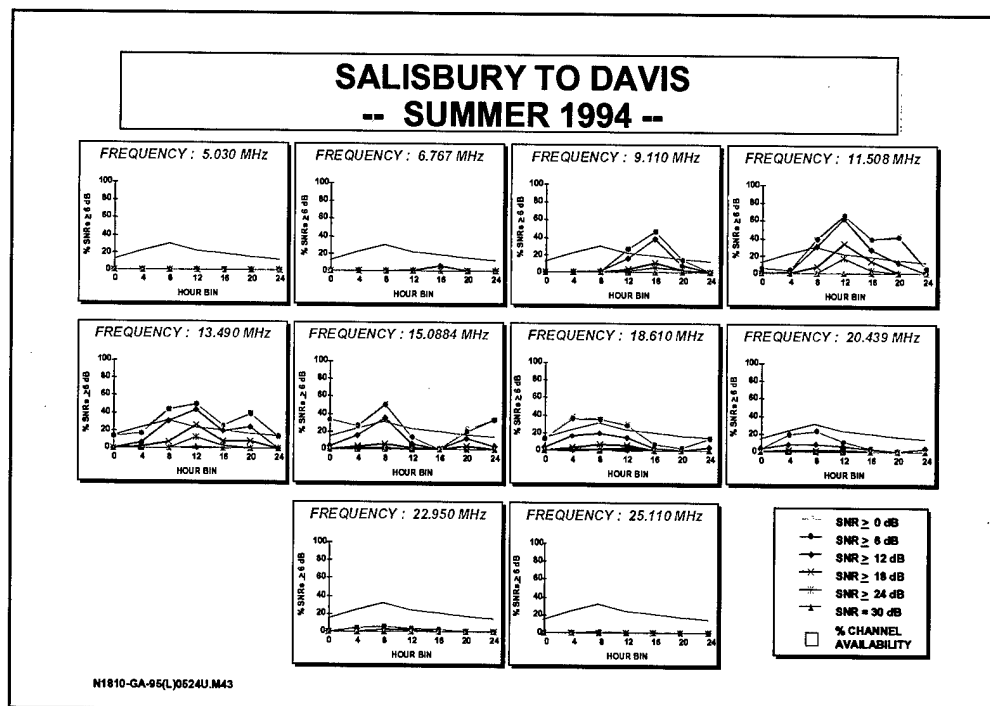


Figure 36. Percent Availability and SNR by Frequency, Salisbury to Davis, Summer 1994

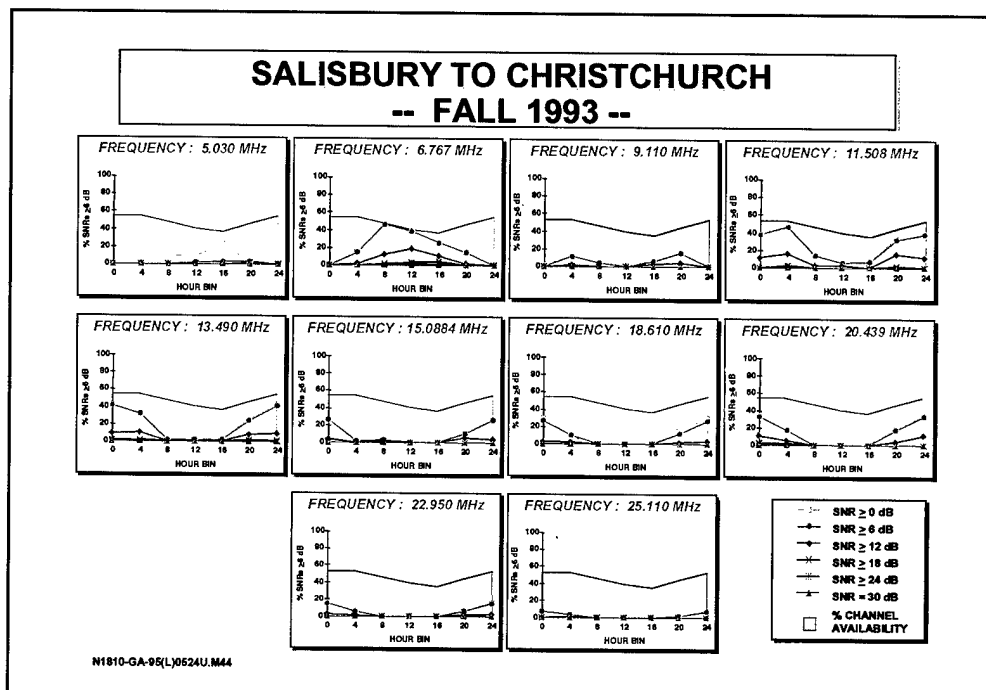


Figure 37. Percent Availability and SNR by Frequency, Salisbury to Christchurch, Fall 1993

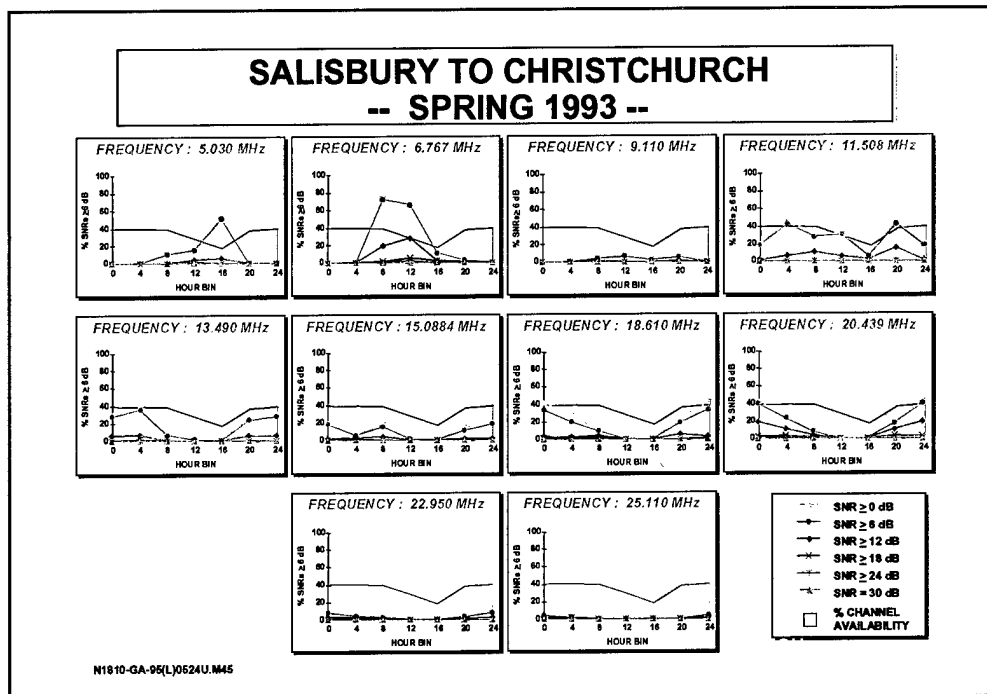


Figure 38. Percent Availability and SNR by Frequency, Salisbury to Christchurch, Spring 1993

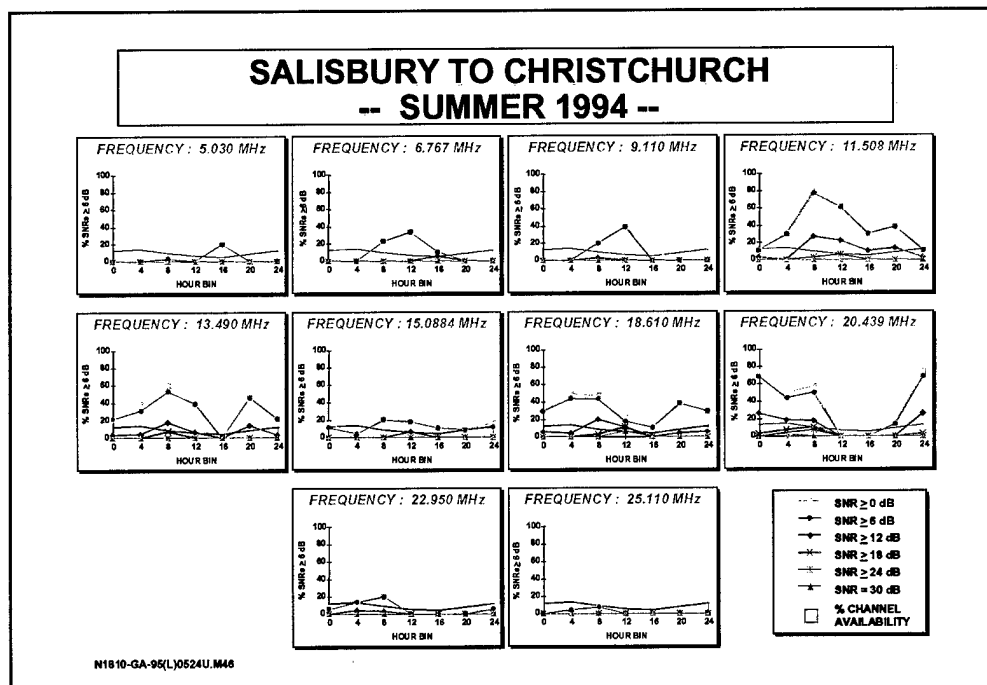


Figure 39. Percent Availability and SNR by Frequency, Salisbury to Christchurch, Summer 1994

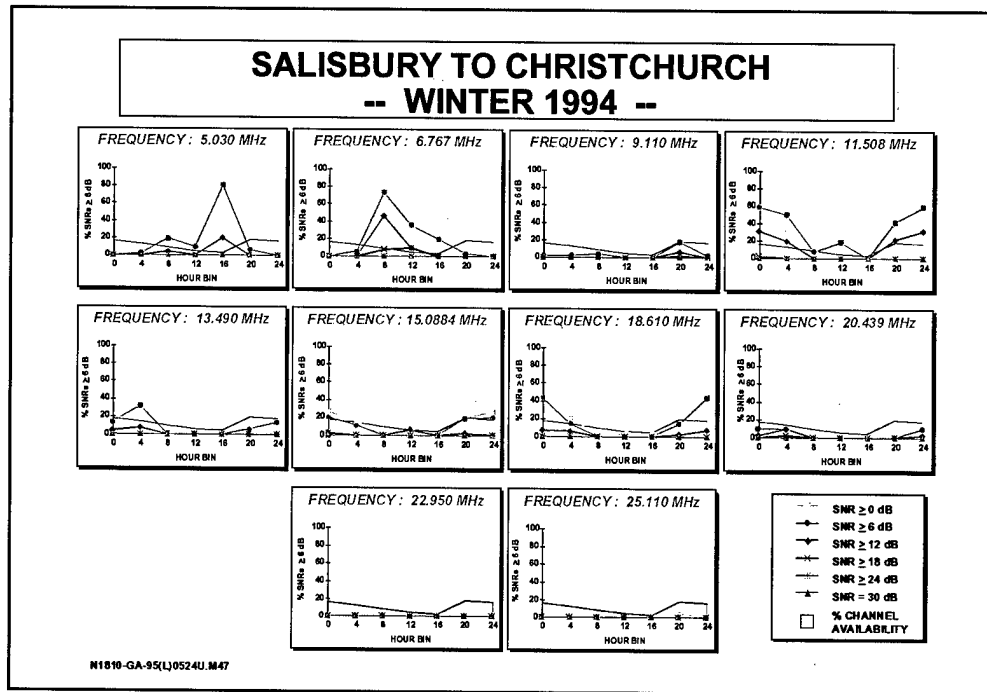


Figure 40. Percent Availability and SNR by Frequency, Salisbury to Christchurch, Winter 1994

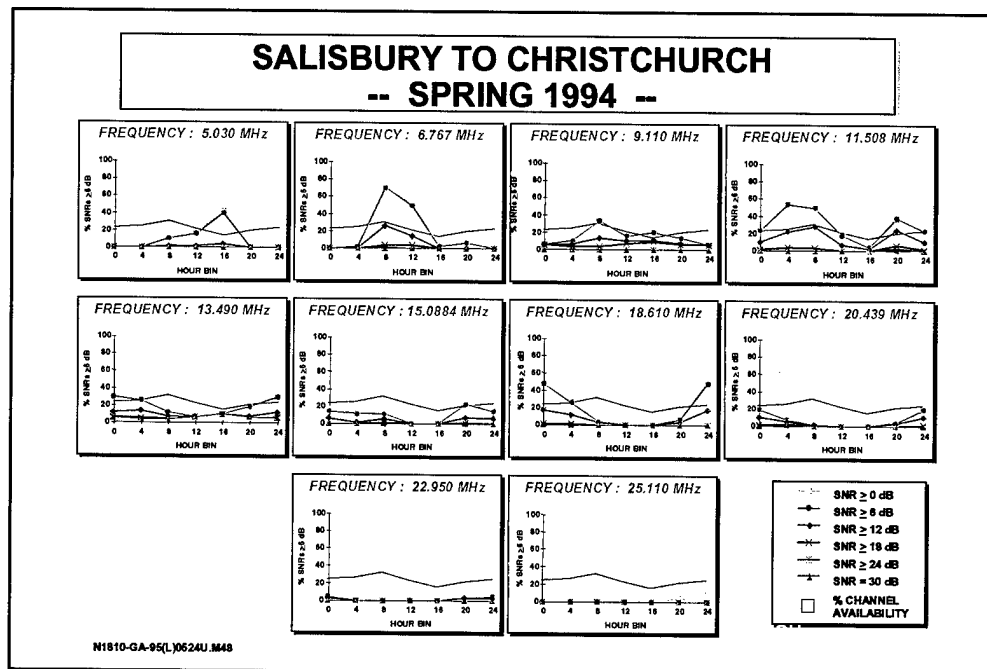


Figure 41. Percent Availability and SNR by Frequency, Salisbury to Christchurch, Spring 1994

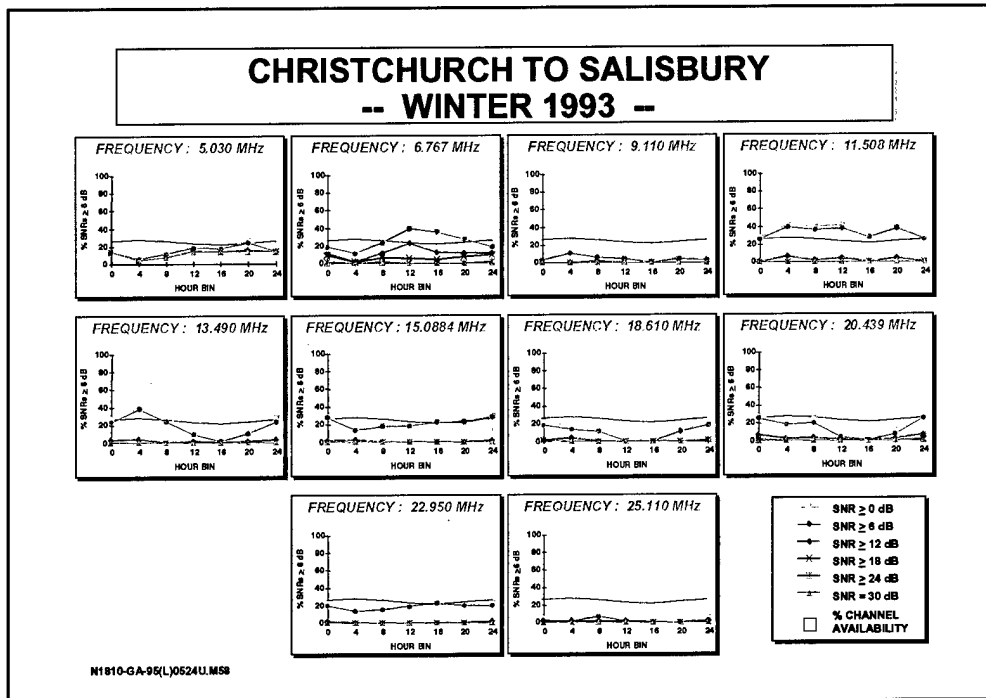


Figure 42. Percent Availability and SNR by Frequency, Christchurch to Salisbury, Winter 1993

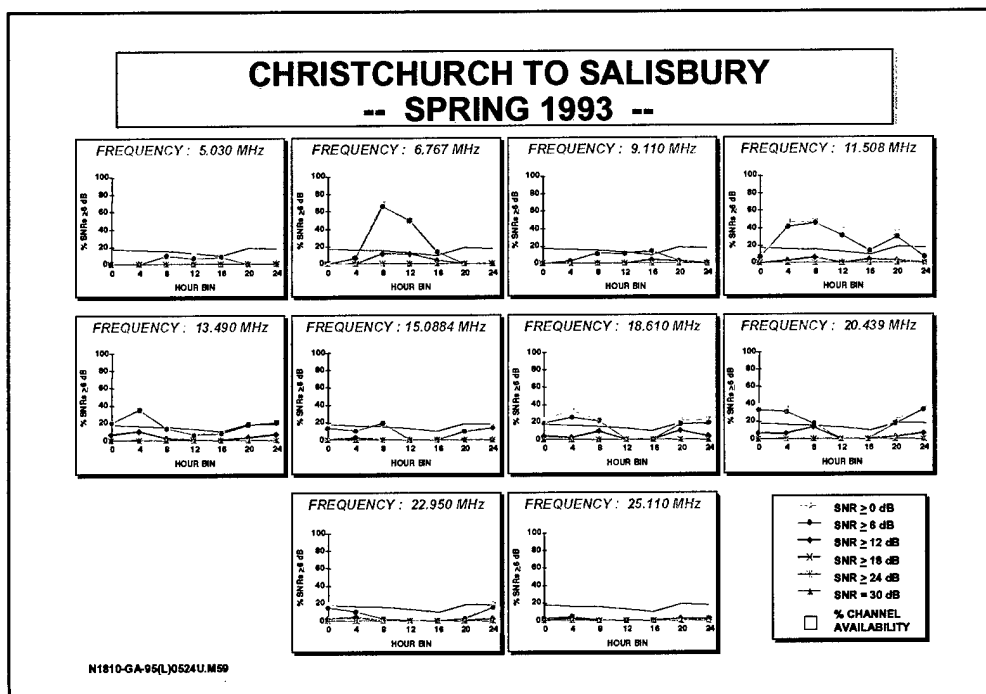


Figure 43. Percent Availability and SNR by Frequency, Christchurch to Salisbury, Spring 1993

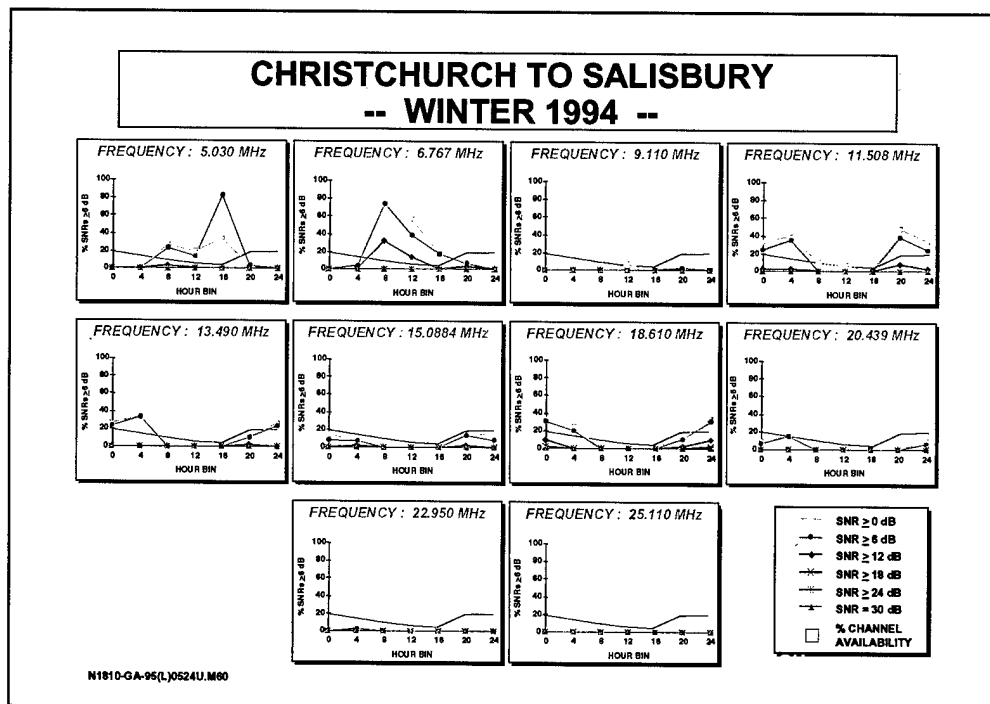


Figure 44. Percent Availability and SNR by Frequency, Christchurch to Salisbury, Winter 1994

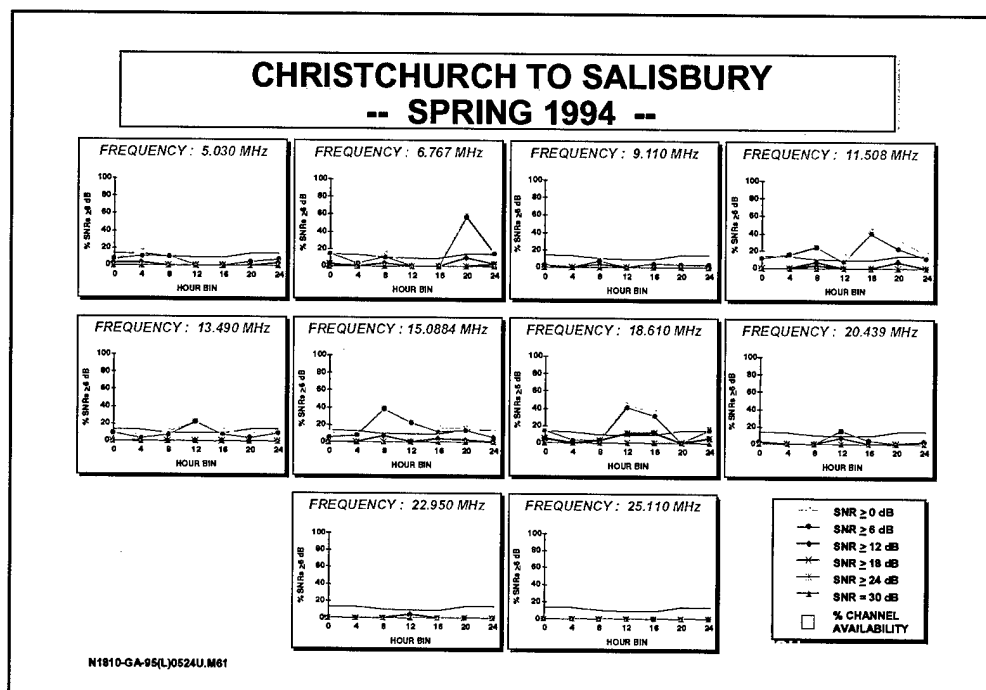


Figure 45. Percent Availability and SNR by Frequency, Christchurch to Salisbury, Spring 1994

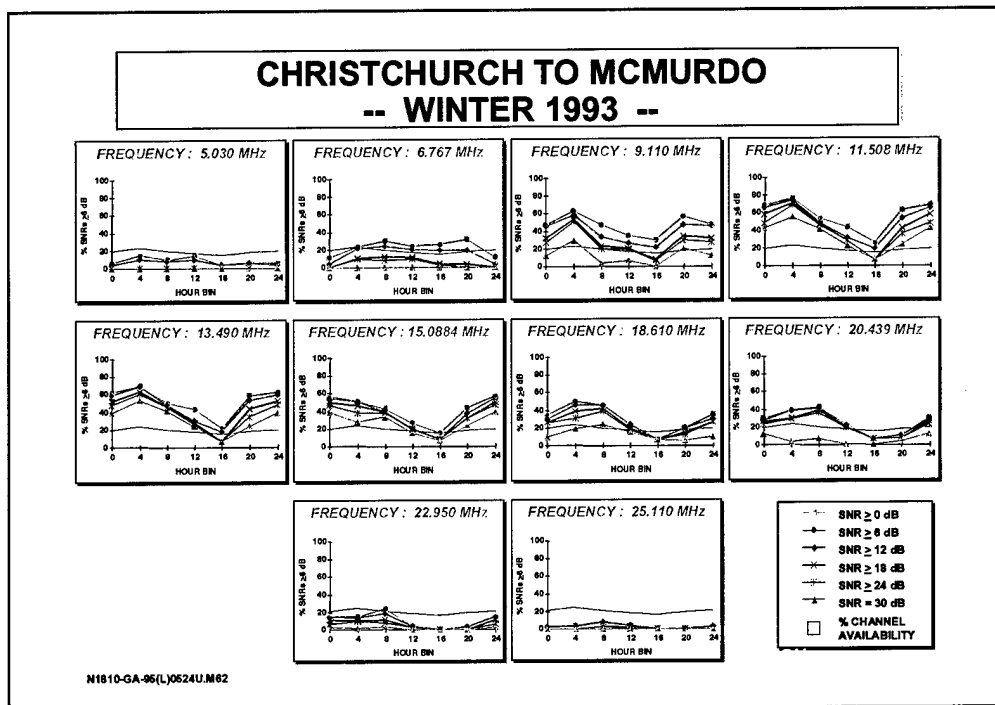


Figure 46. Percent Availability and SNR by Frequency, Christchurch to McMurdo, Winter 1993

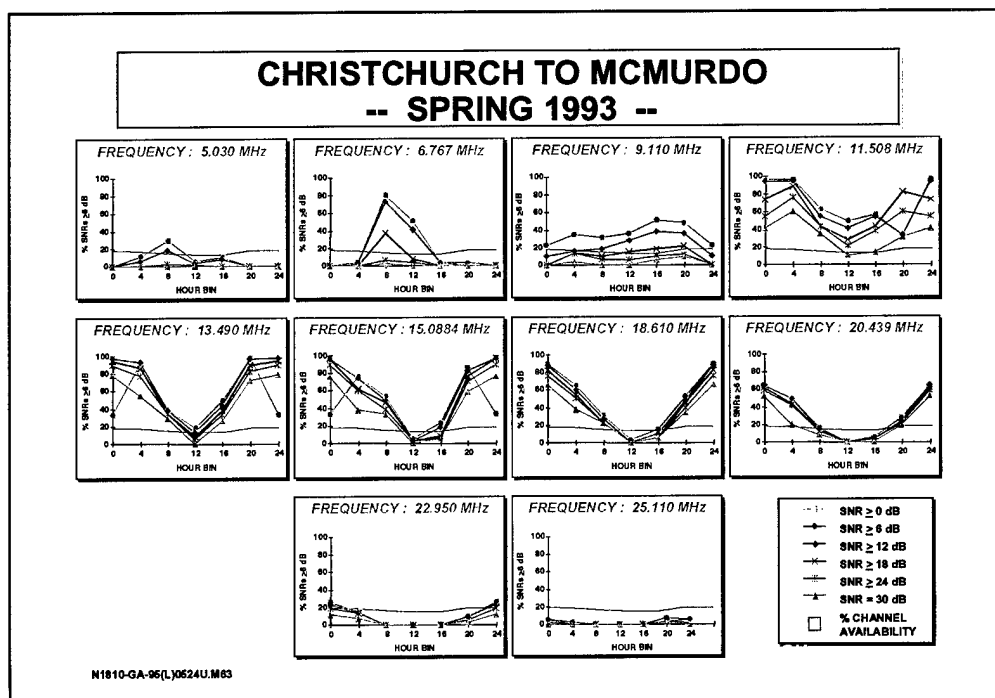


Figure 47. Percent Availability and SNR by Frequency, Christchurch to McMurdo, Spring 1993

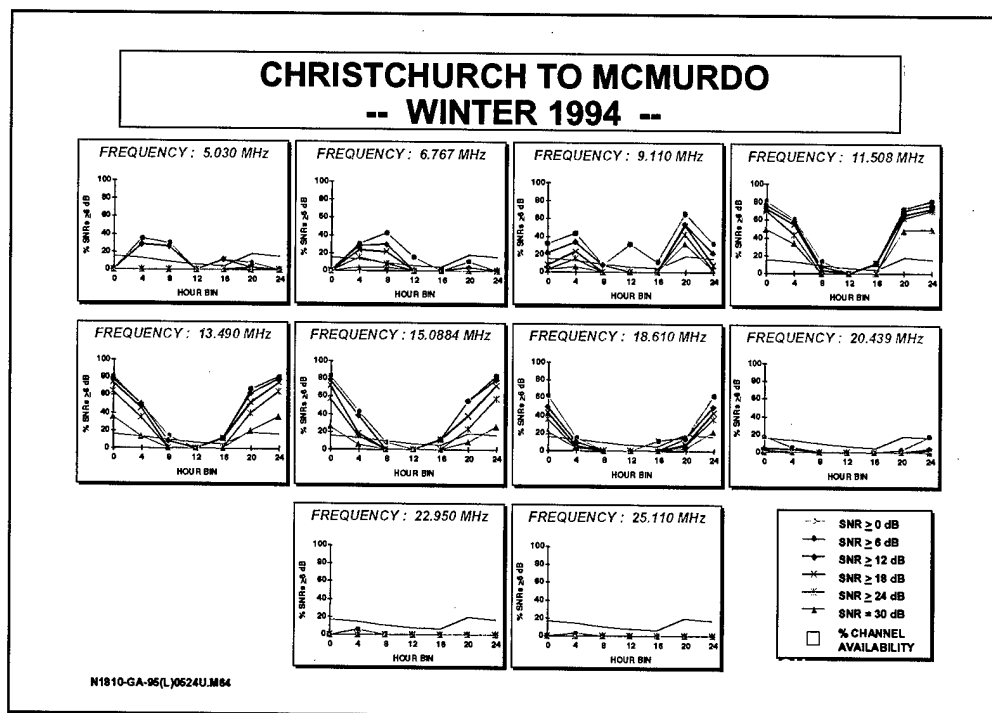


Figure 48. Percent Availability and SNR by Frequency, Christchurch to McMurdo, Winter 1994

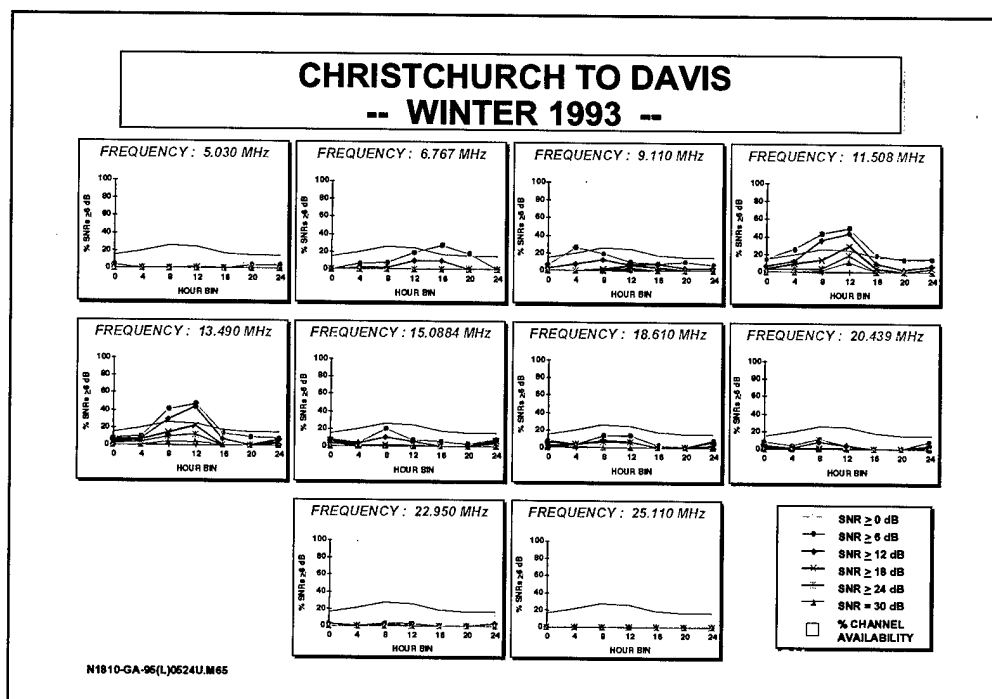


Figure 49. Percent Availability and SNR by Frequency, Christchurch to Davis, Winter 1993

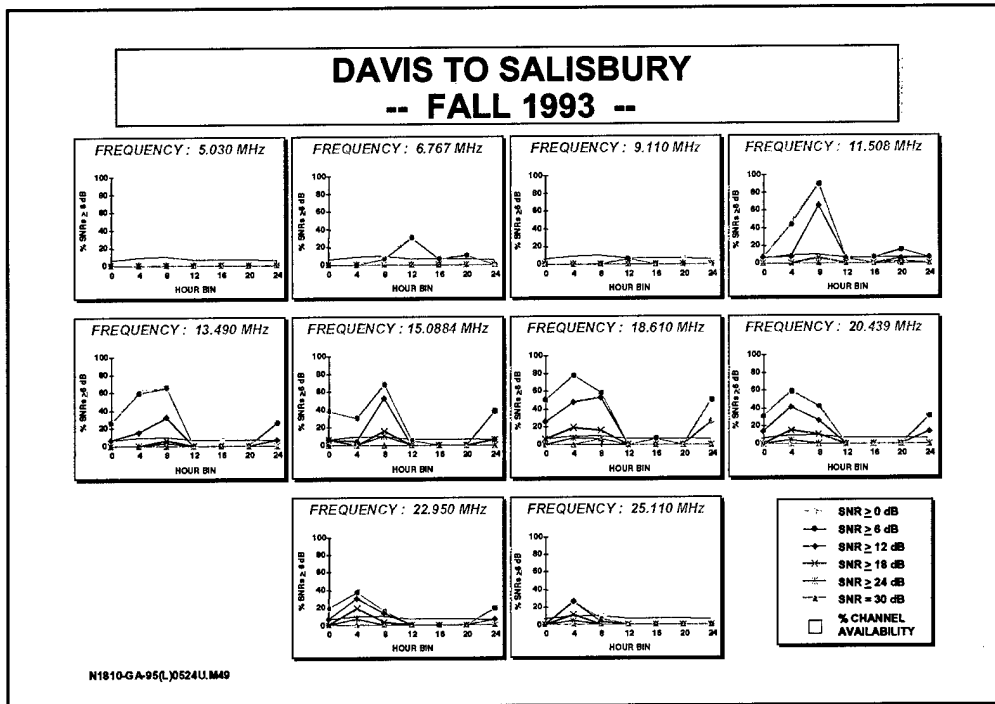


Figure 50. Percent Availability and SNR by Frequency, Davis to Salisbury, Fall 1993

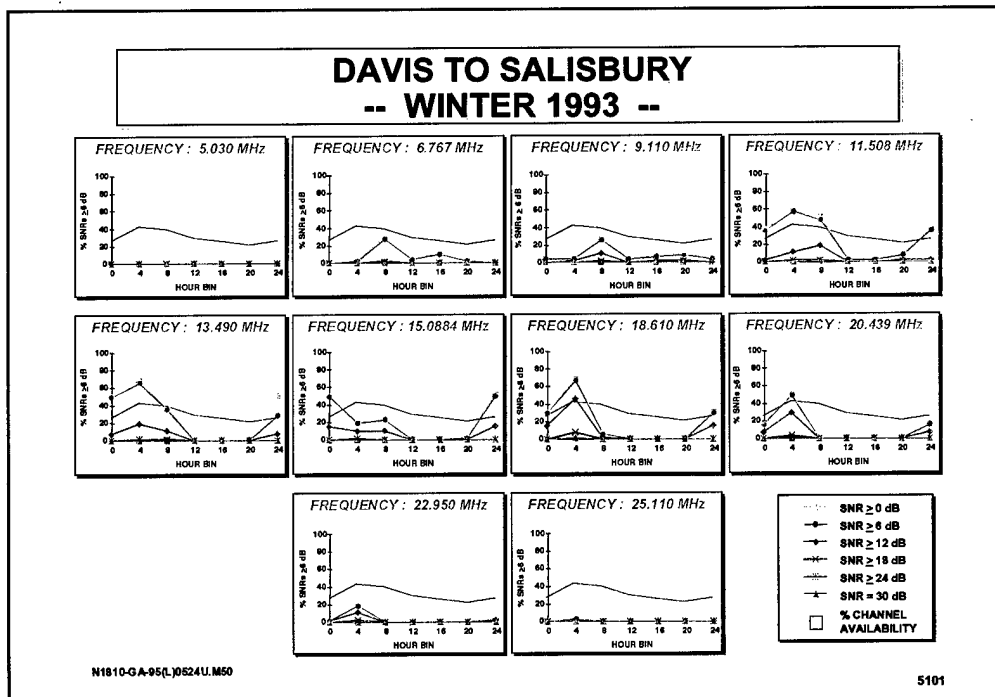


Figure 51. Percent Availability and SNR by Frequency, Davis to Salisbury, Winter 1993

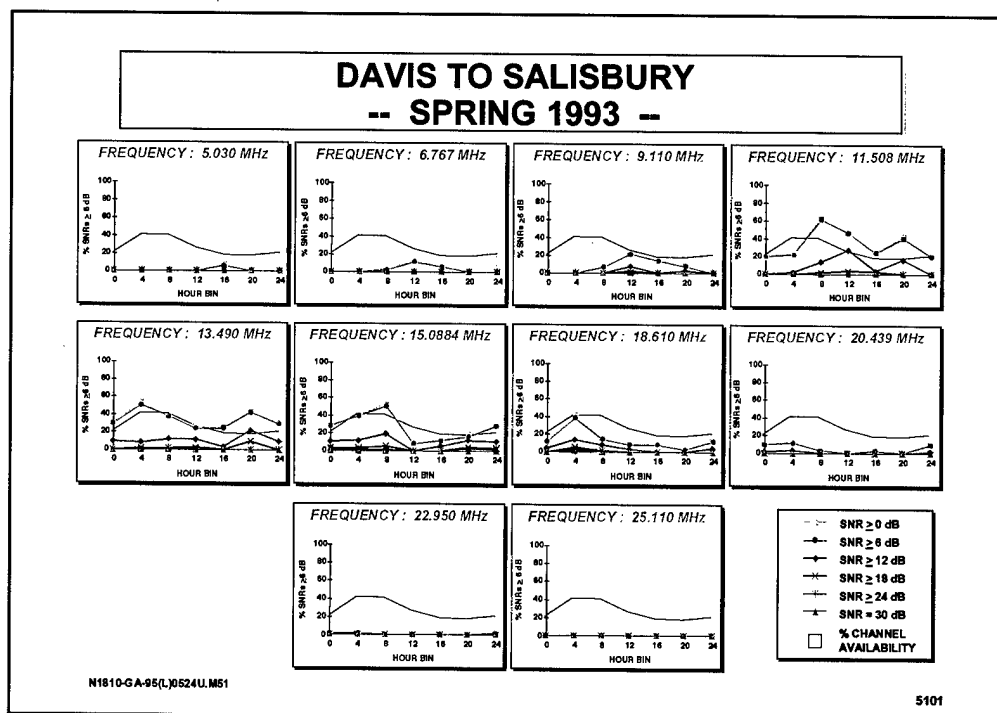


Figure 52. Percent Availability and SNR by Frequency, Davis to Salisbury, Spring 1993

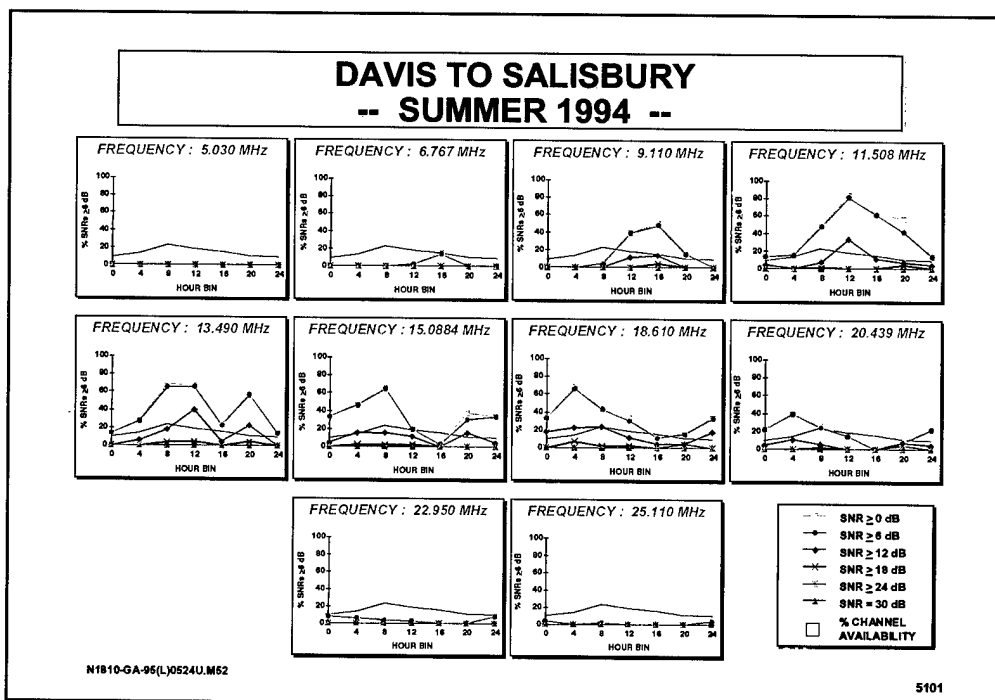


Figure 53. Percent Availability and SNR by Frequency, Davis to Salisbury, Summer 1994

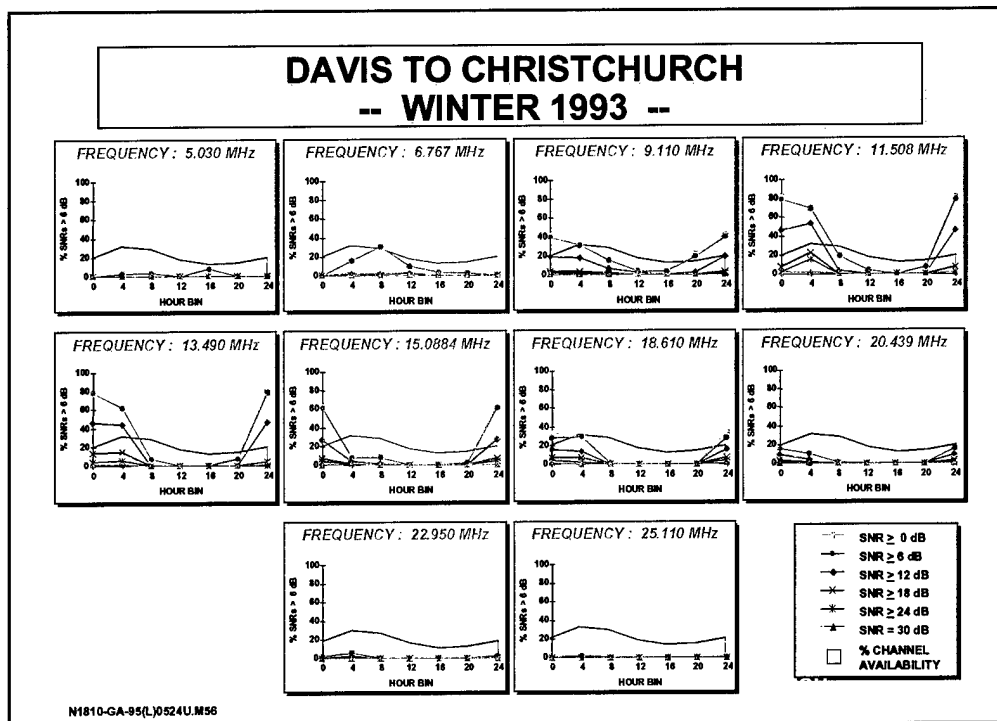


Figure 54. Percent Availability and SNR by Frequency, Davis to Christchurch, Winter 1993

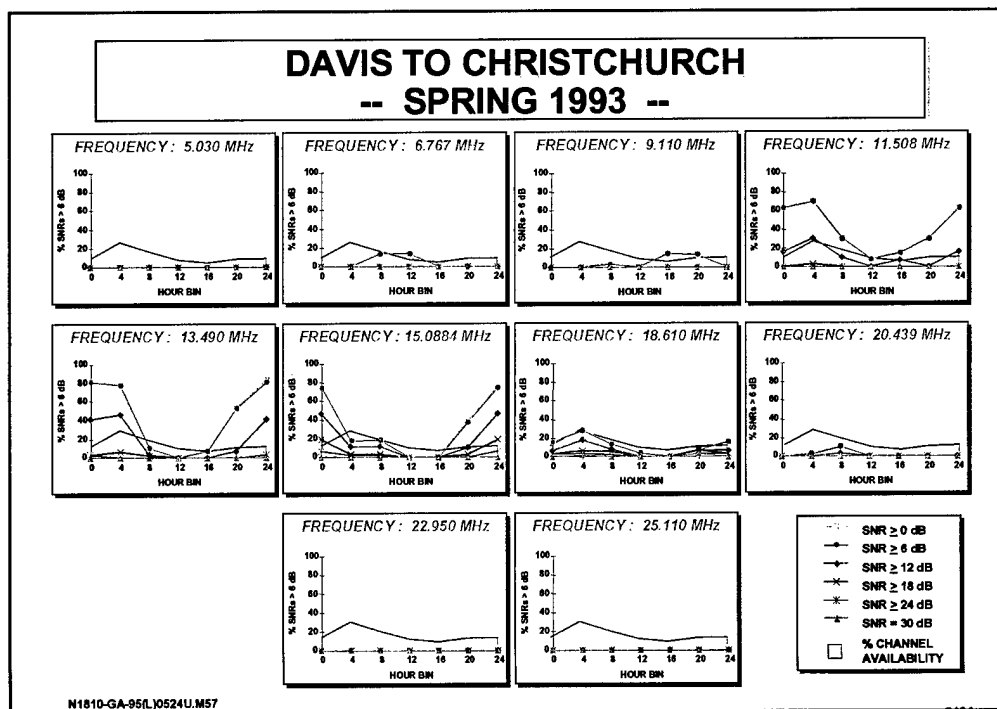


Figure 55. Percent Availability and SNR by Frequency, Davis to Christchurch, Spring 1993

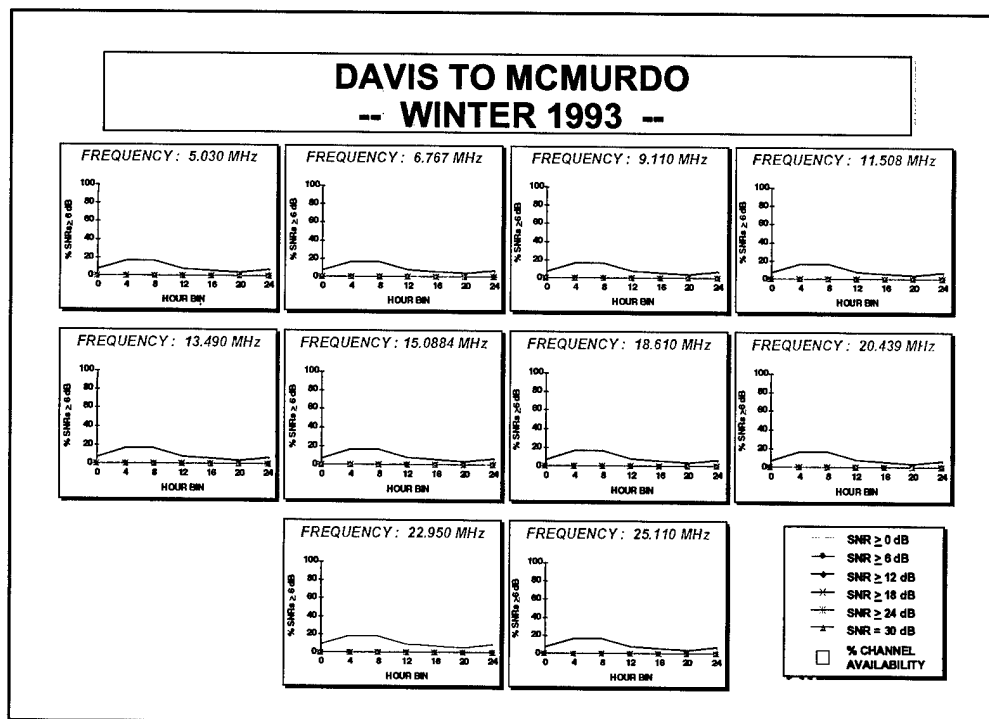


Figure 56. Percent Availability and SNR by Frequency, Davis to McMurdo, Winter 1993

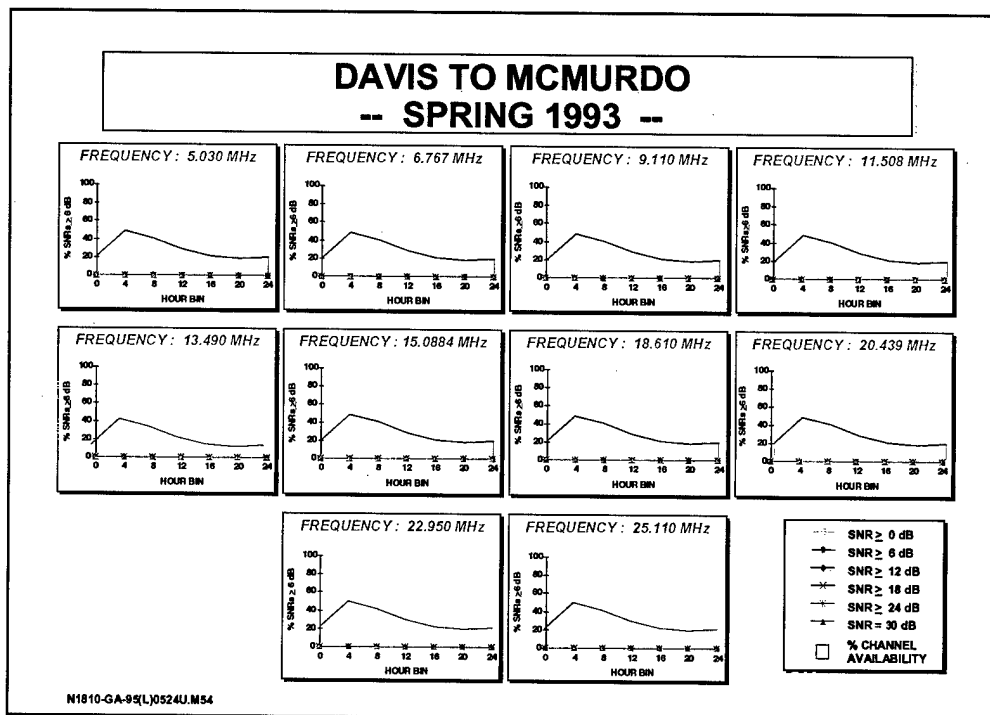


Figure 57. Percent Availability and SNR by Frequency, Davis to McMurdo, Spring 1993

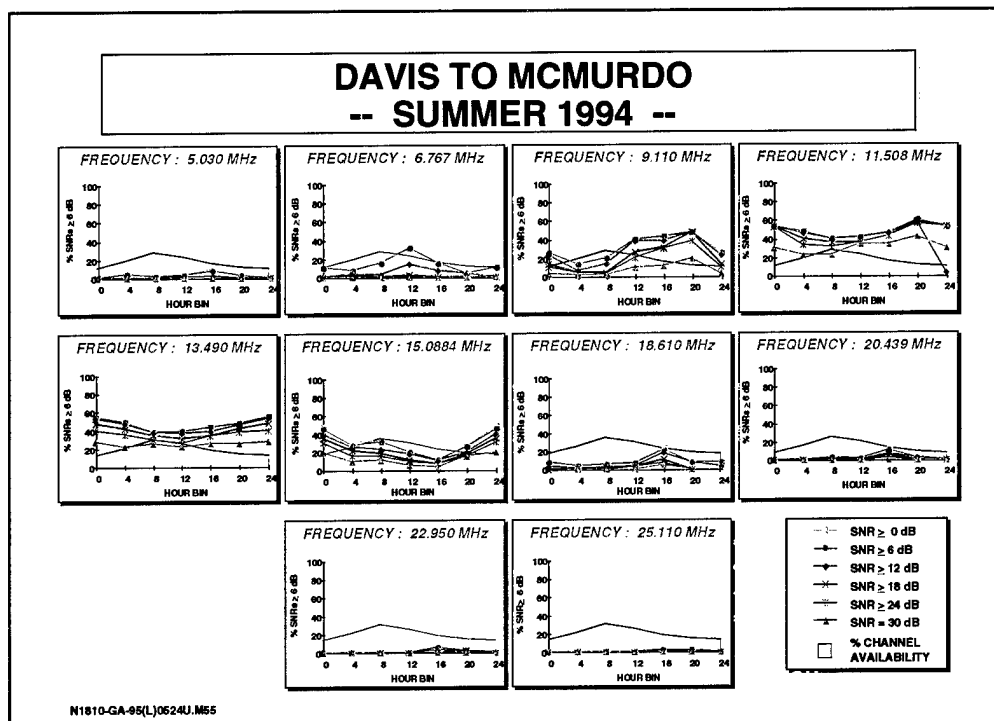


Figure 58. Percent Availability and SNR by Frequency, Davis to McMurdo, Summer 1994

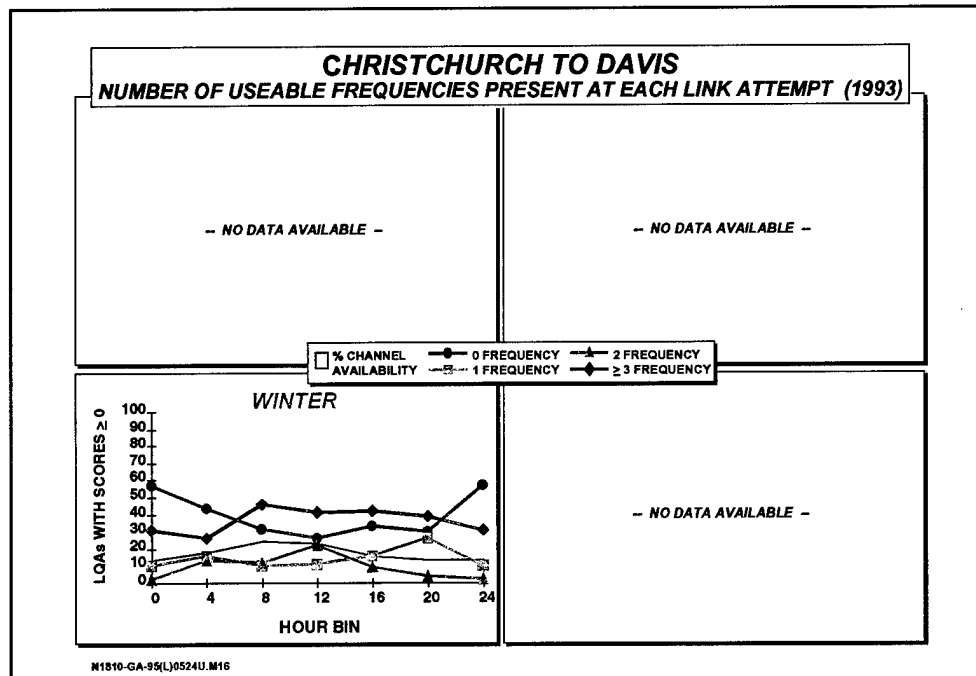


Figure 59. Number of Usable Frequencies at Each Link Attempt, Christchurch to Davis, 1993

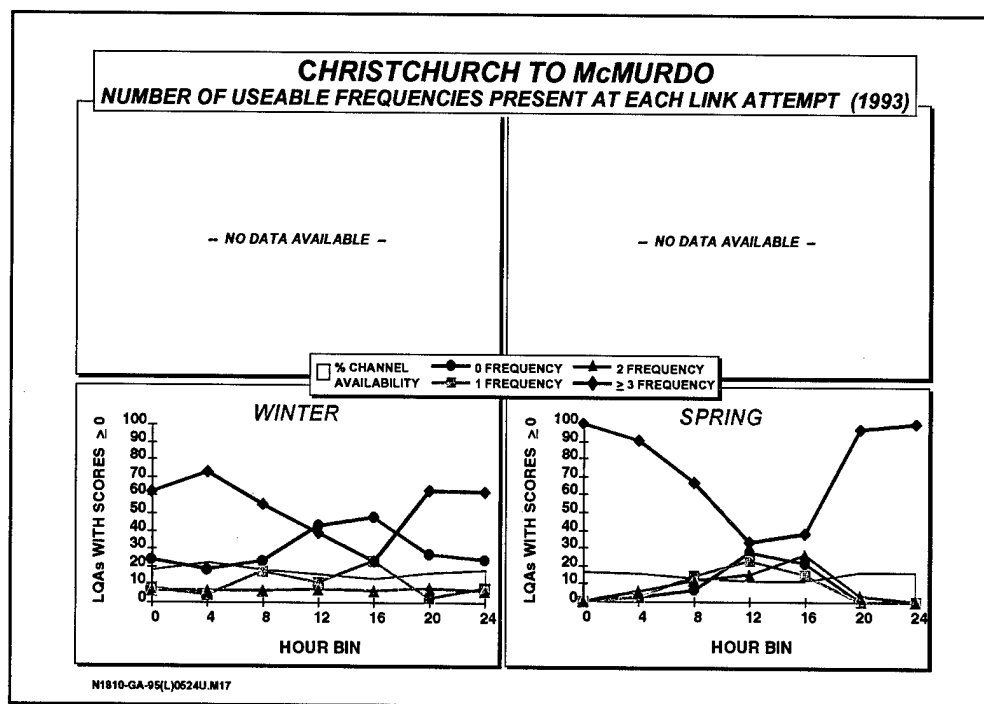


Figure 60. Number of Usable Frequencies at Each Link Attempt, Christchurch to McMurdo, 1993

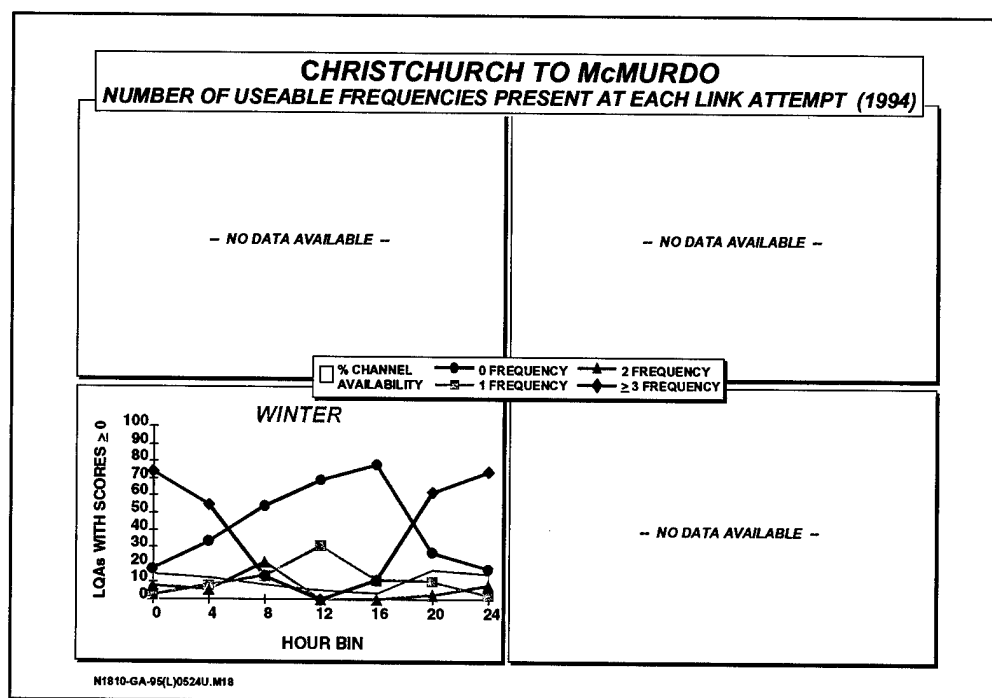


Figure 61. Number of Usable Frequencies at Each Link Attempt, Christchurch to McMurdo, 1994

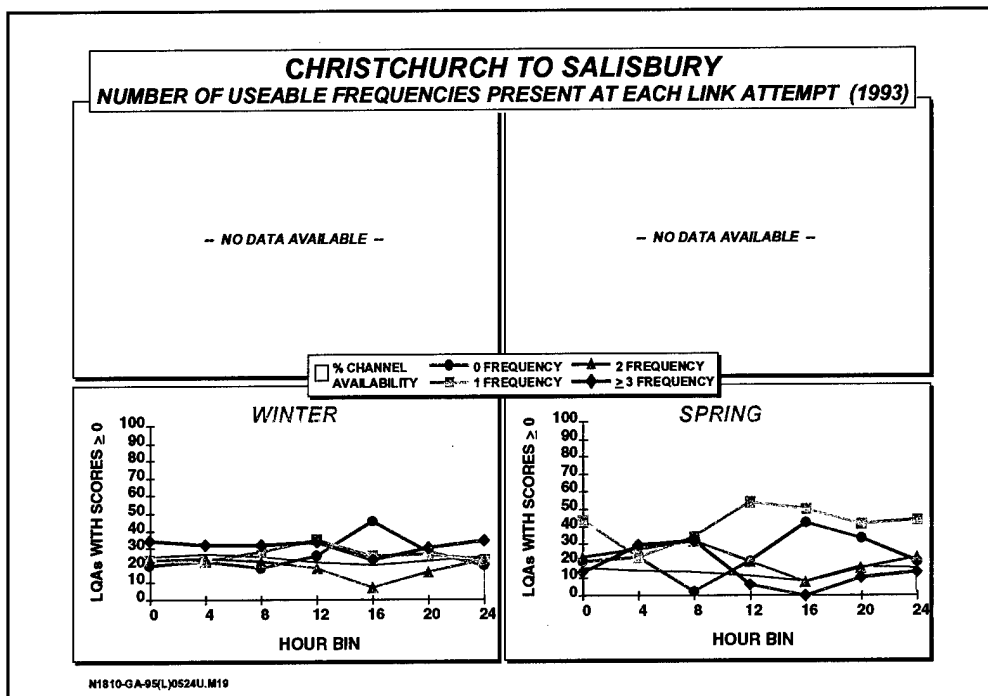


Figure 62. Number of Usable Frequencies at Each Link Attempt, Christchurch to Salisbury, 1993

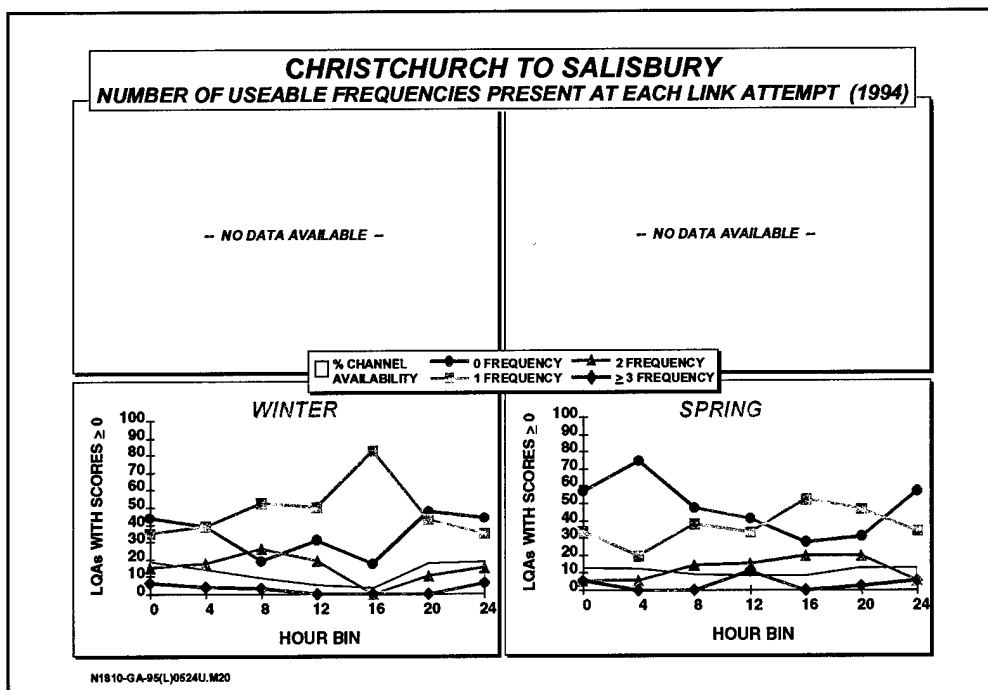


Figure 63. Number of Usable Frequencies at Each Link Attempt, Christchurch to Salisbury, 1994

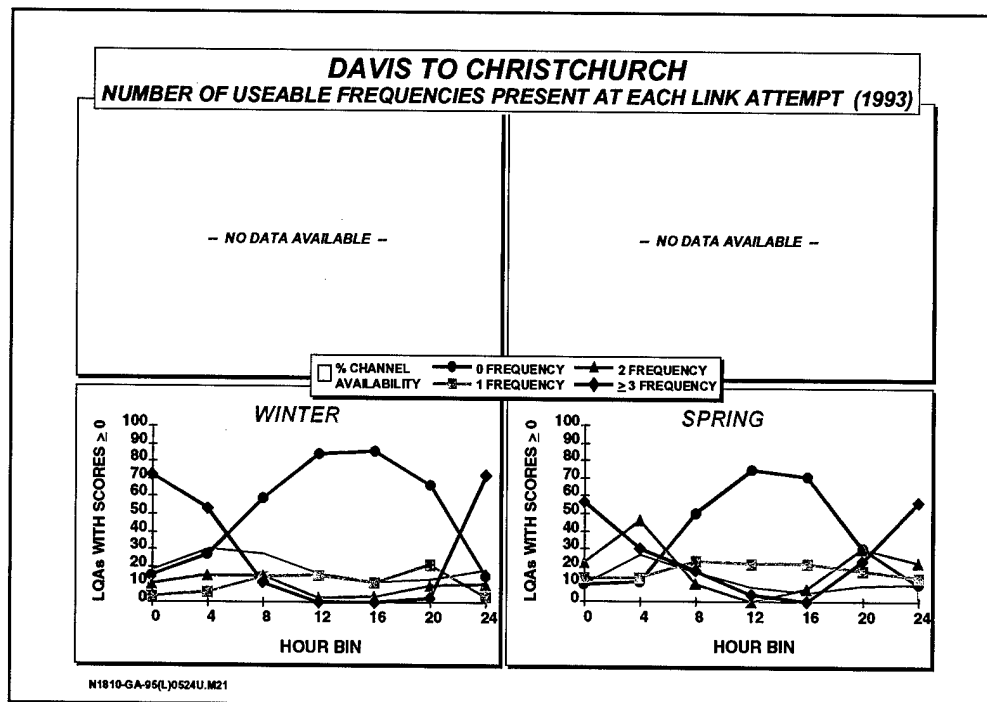


Figure 64. Number of Usable Frequencies at Each Link Attempt, Davis to Christchurch, 1993

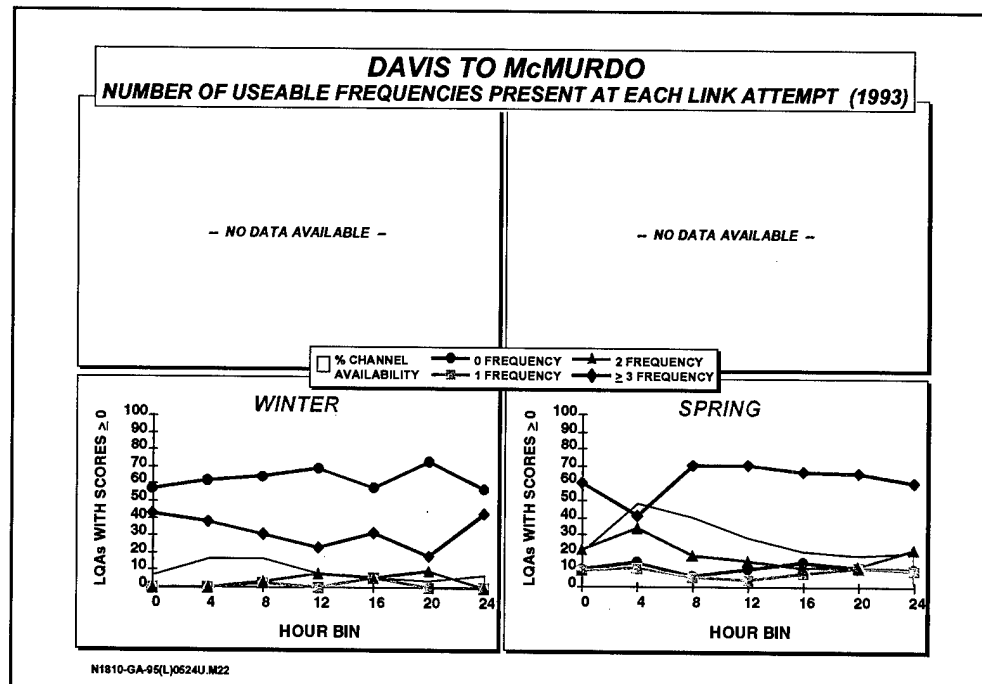


Figure 65. Number of Usable Frequencies at Each Link Attempt, Davis to McMurdo, 1993

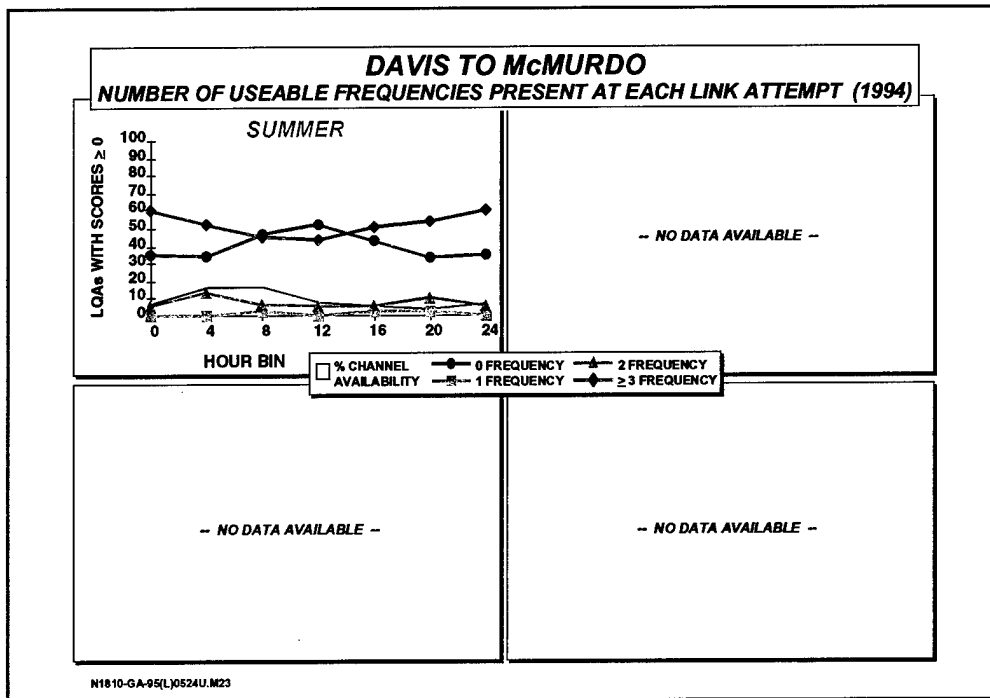


Figure 66. Number of Usable Frequencies at Each Link Attempt, Davis to McMurdo, 1994

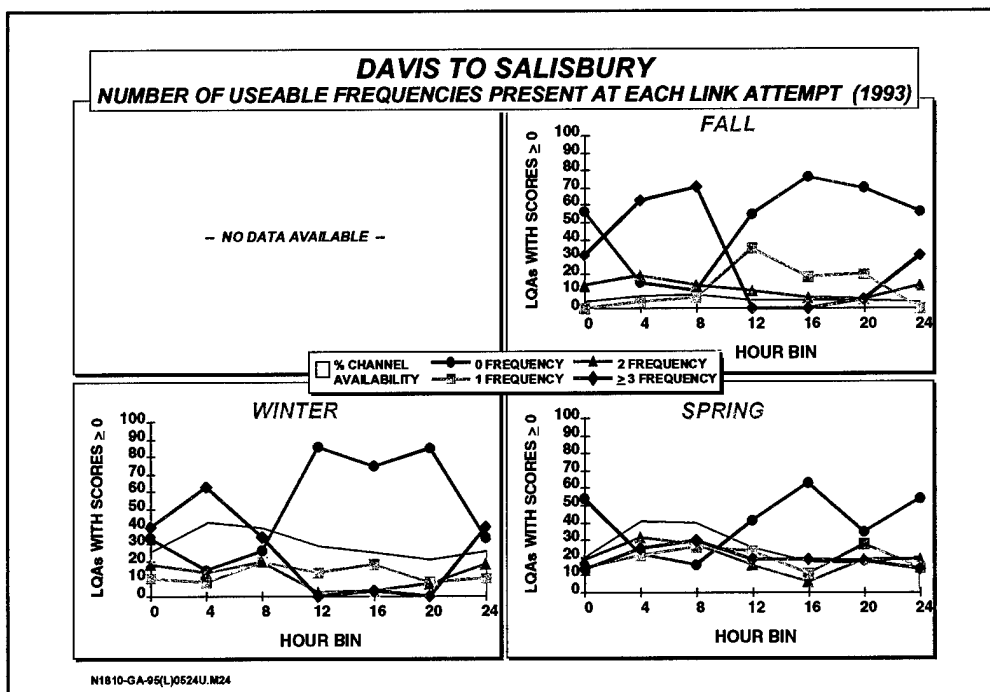


Figure 67. Number of Usable Frequencies at Each Link Attempt, Davis to Salisbury, 1993

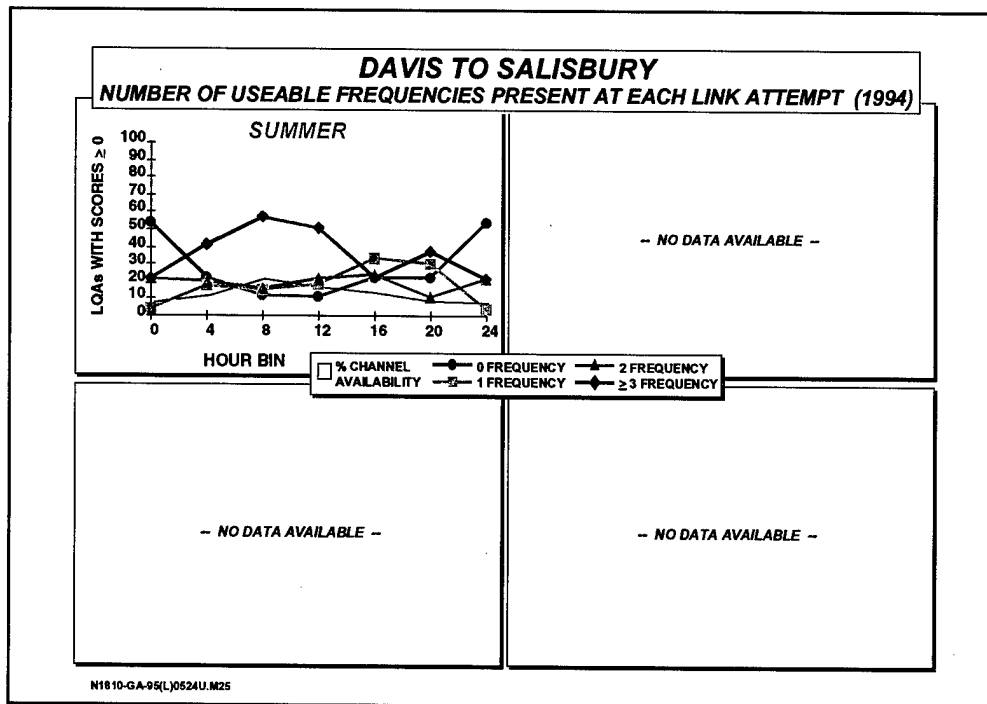


Figure 68. Number of Usable Frequencies at Each Link Attempt, Davis to Salisbury, 1994

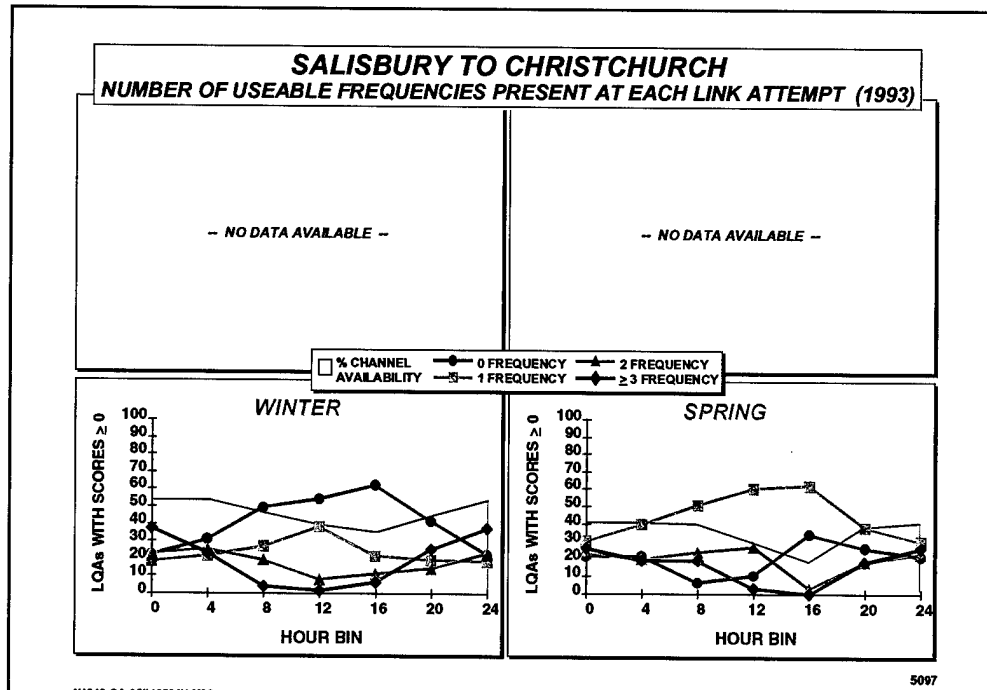


Figure 69. Number of Usable Frequencies at Each Link Attempt, Salisbury to Christchurch, 1993

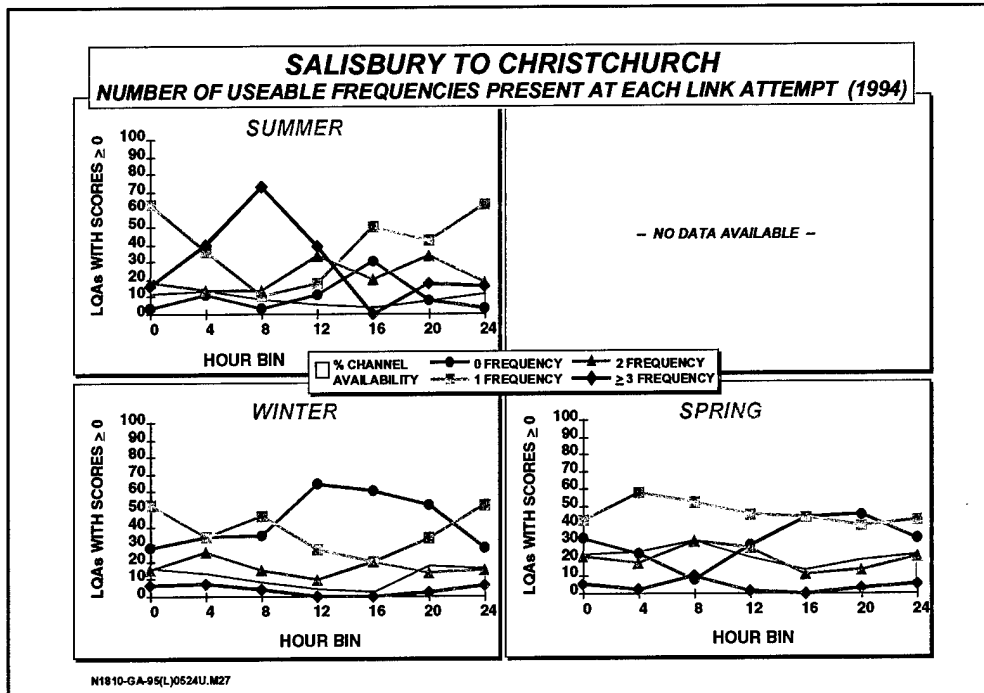


Figure 70. Number of Usable Frequencies at Each Link Attempt, Salisbury to Christchurch, 1994

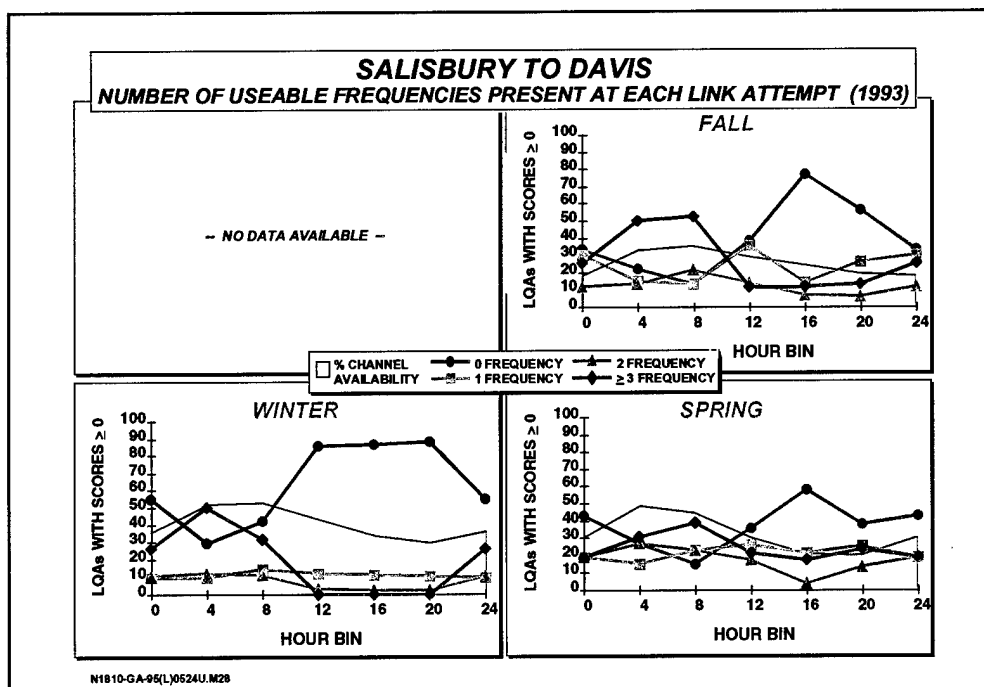


Figure 71. Number of Usable Frequencies at Each Link Attempt, Salisbury to Davis, 1993

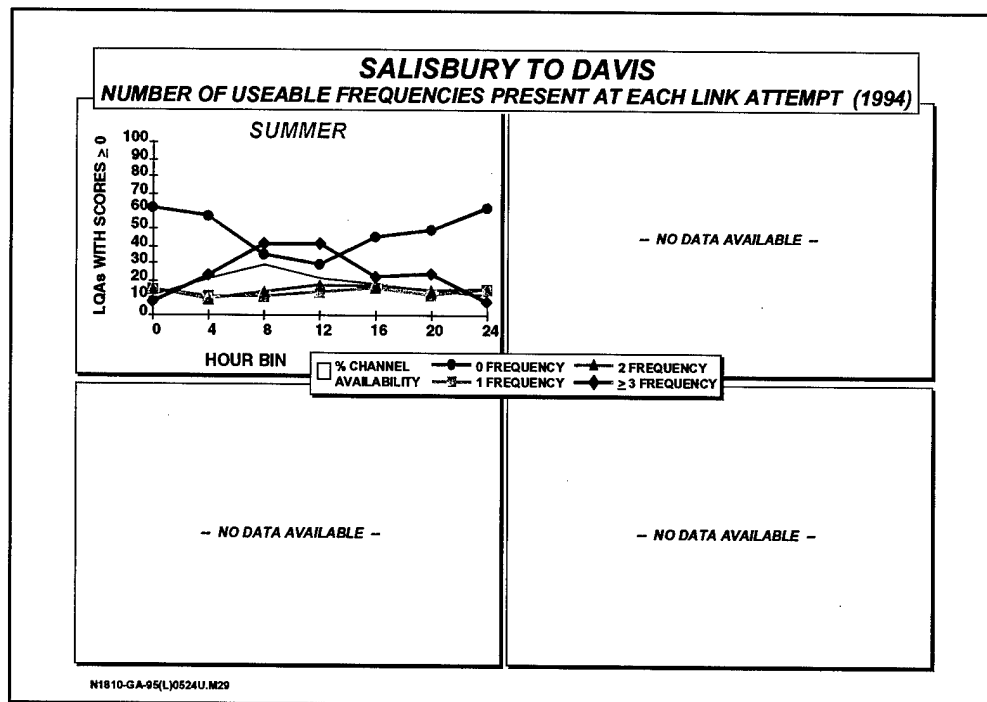


Figure 72. Number of Usable Frequencies at Each Link Attempt, Salisbury to Davis, 1994

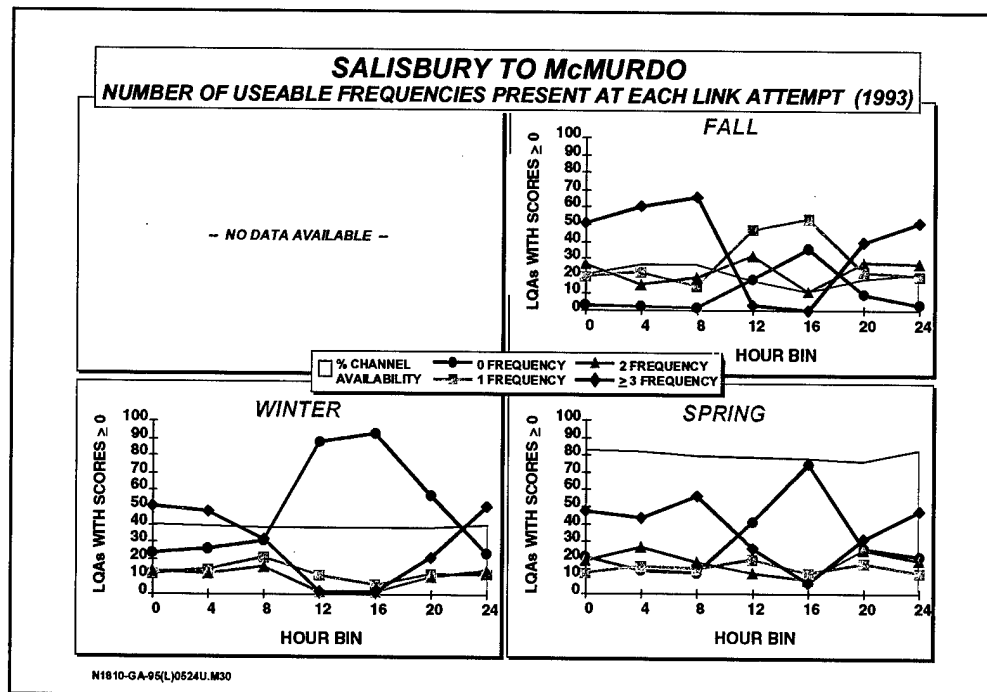


Figure 73. Number of Usable Frequencies at Each Link Attempt, Salisbury to McMurdo, 1993

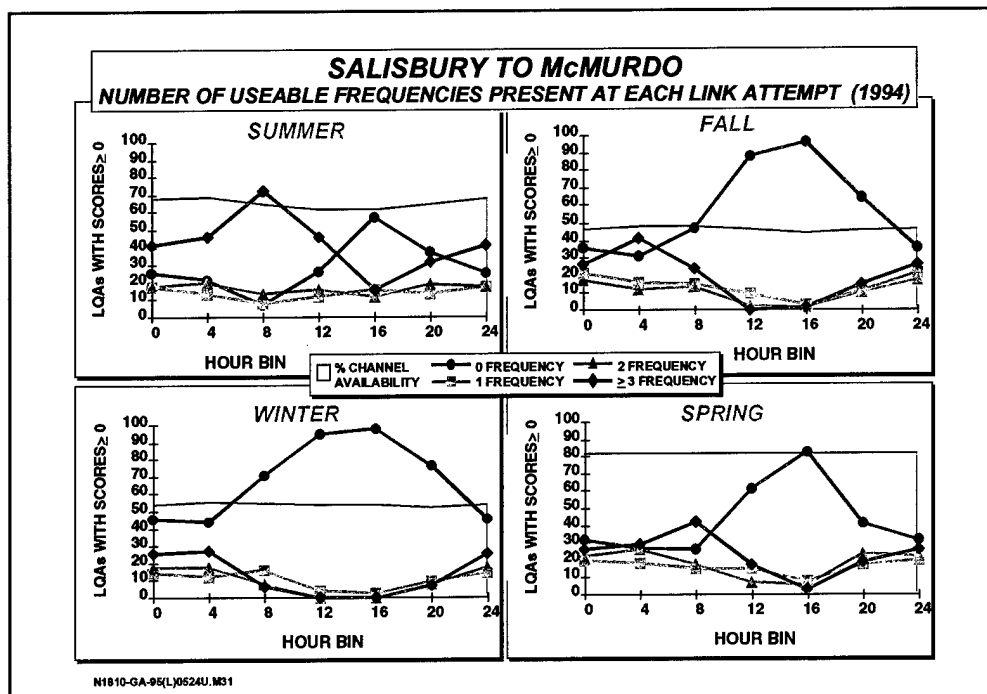
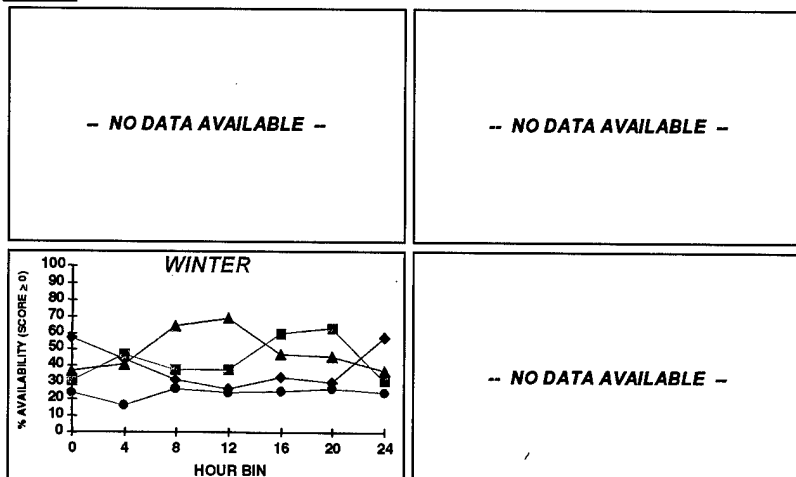


Figure 74. Number of Usable Frequencies at Each Link Attempt, Salisbury to McMurdo, 1994

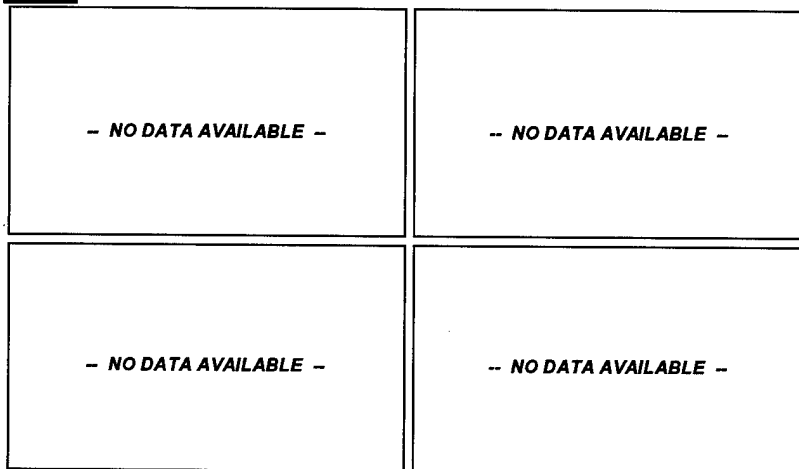
CHRISTCHURCH TO DAVIS

1993



◆ NO FREQ AVAIL. ▲ % OF 11-15 MHz AVAIL.
 ■ % OF 5-9 MHz AVAIL. ● % OF 18-25 MHz AVAIL.

1994

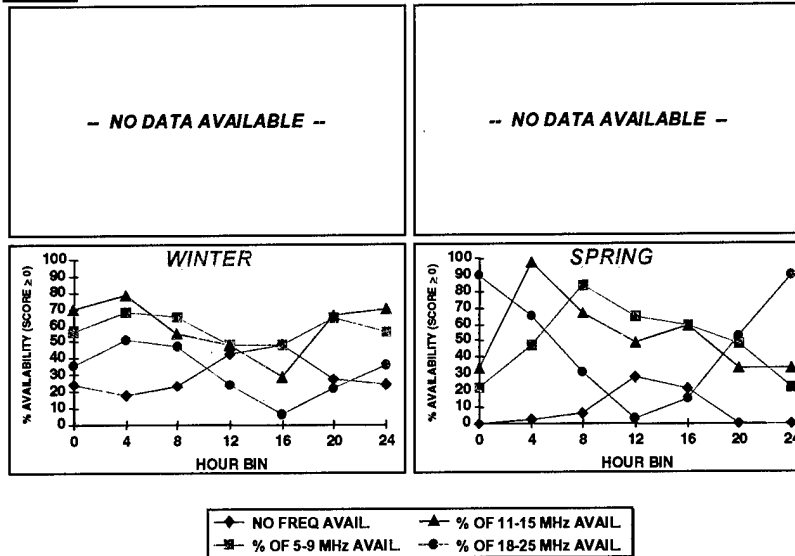


N1810-GA-95(L)0524U.M66

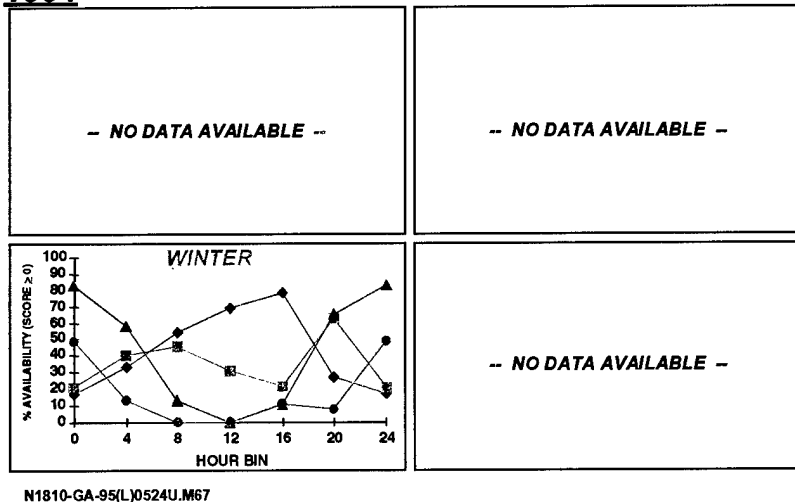
Figure 75. Percent Availability of Each Frequency Group by Season, Christchurch to Davis

CHRISTCHURCH TO MCMURDO

1993



1994

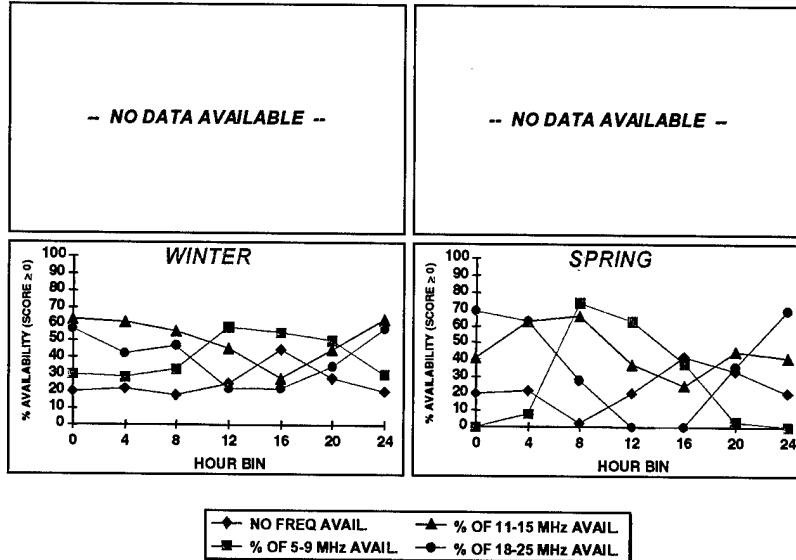


N1810-GA-95(L)0524U.M67

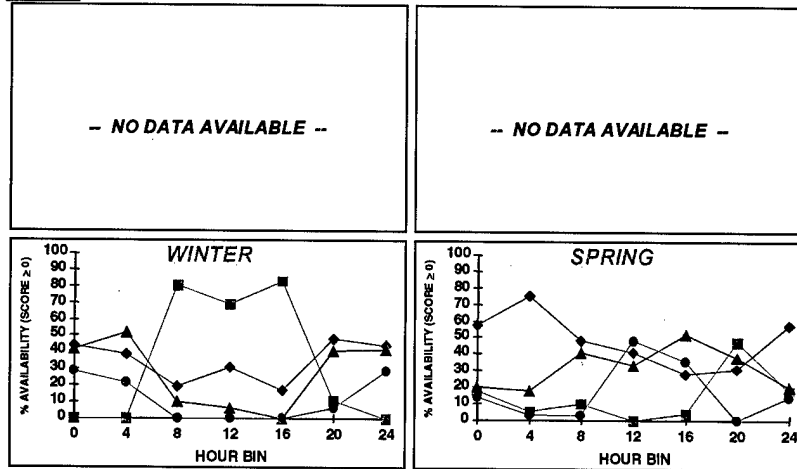
Figure 76. Percent Availability of Each Frequency Group by Season, Christchurch to McMurdo

CHRISTCHURCH TO SALISBURY

1993



1994

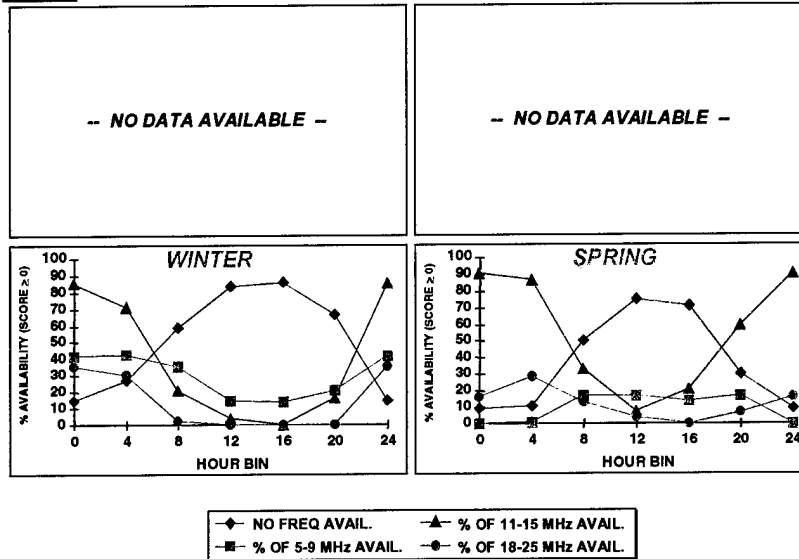


N1810-GA-95(L)0524U.M68

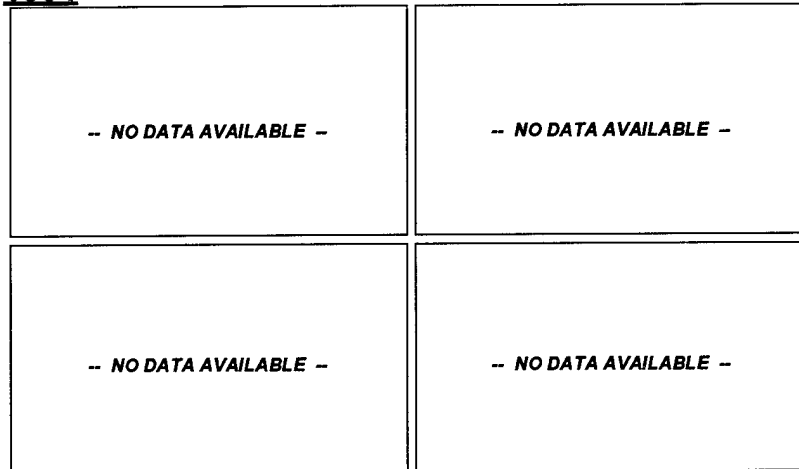
Figure 77. Percent Availability of Each Frequency Group by Season, Christchurch to Salisbury

DAVIS TO CHRISTCHURCH

1993



1994

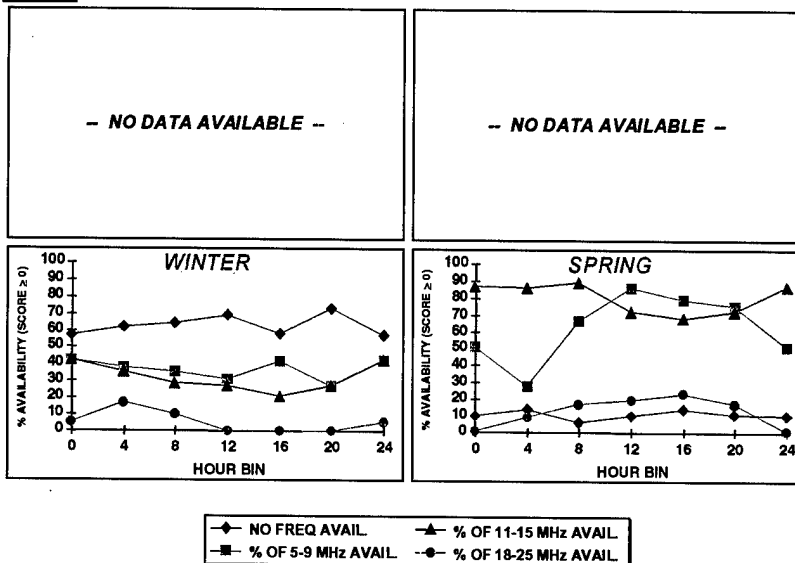


N1810-GA-95(L)0524U.M69

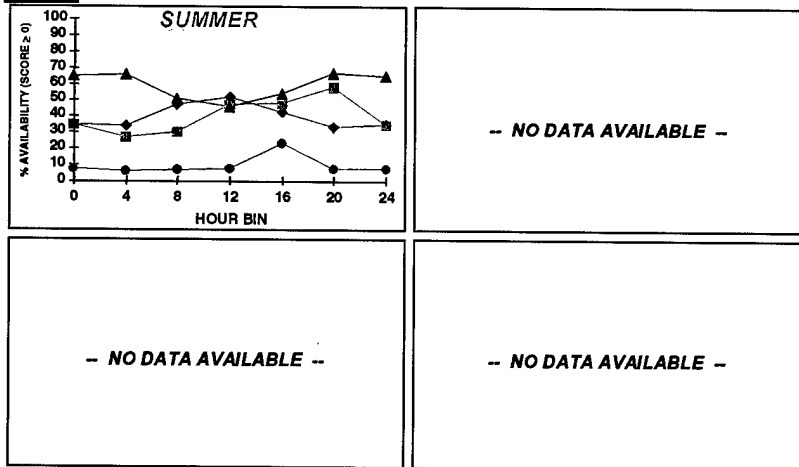
Figure 78. Percent Availability of Each Frequency Group by Season, Davis to Christchurch

DAVIS TO MCMURDO

1993



1994

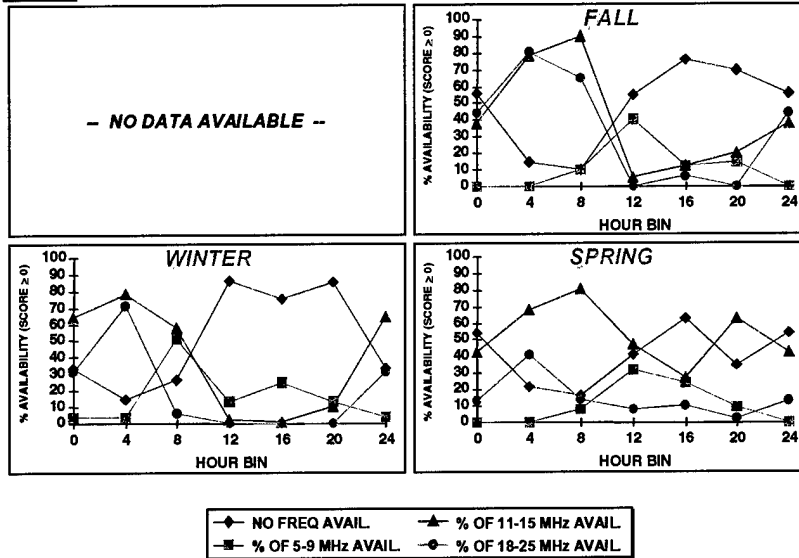


N1810-GA-95(L)0524U.M70

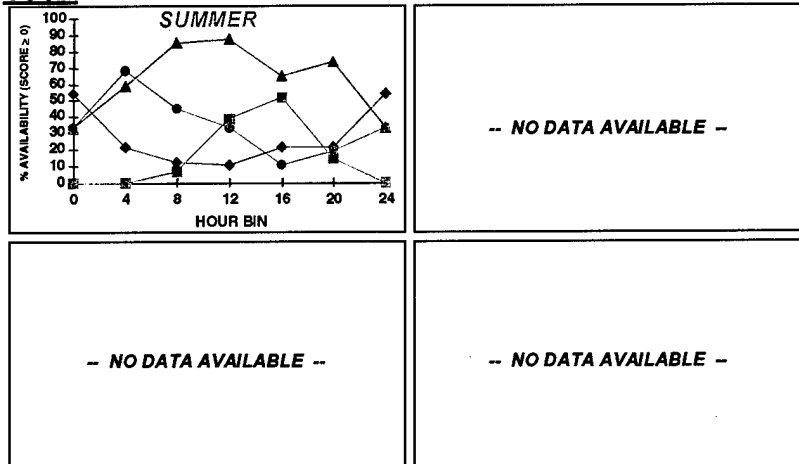
Figure 79. Percent Availability of Each Frequency Group by Season, Davis to McMurdo

DAVIS TO SALISBURY

1993



1994

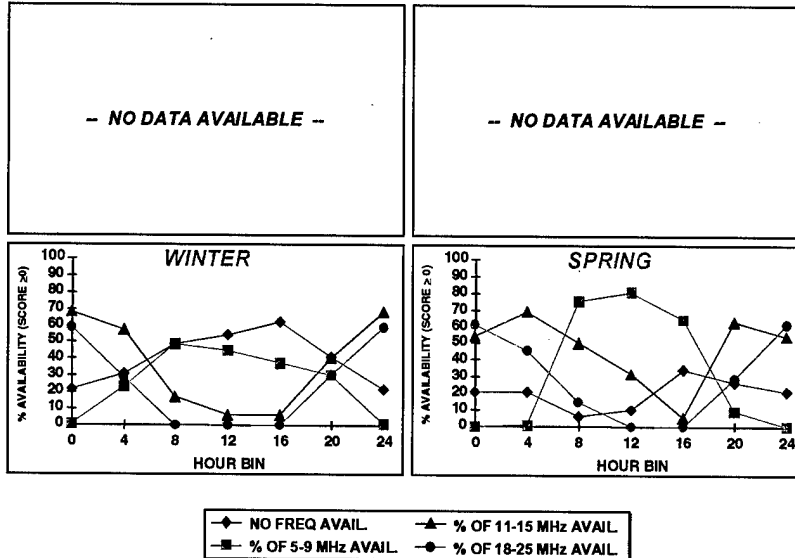


N1810-GA-95(L)0524U.M71

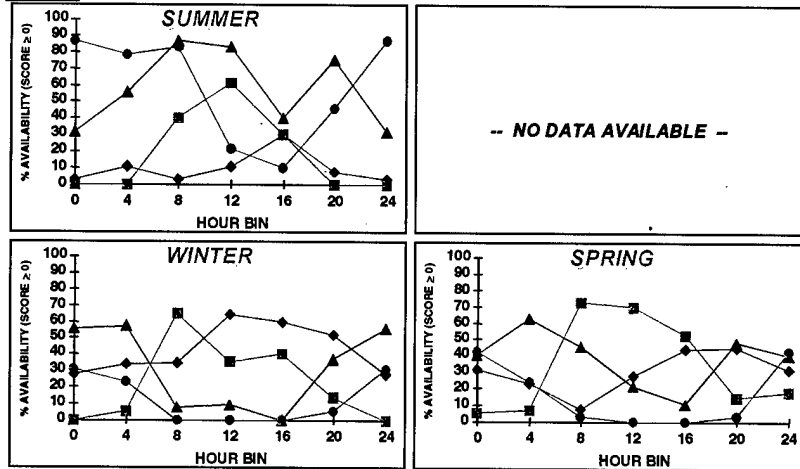
Figure 80. Percent Availability of Each Frequency Group by Season, Davis to Salisbury

SALISBURY TO CHRISTCHURCH

1993



1994

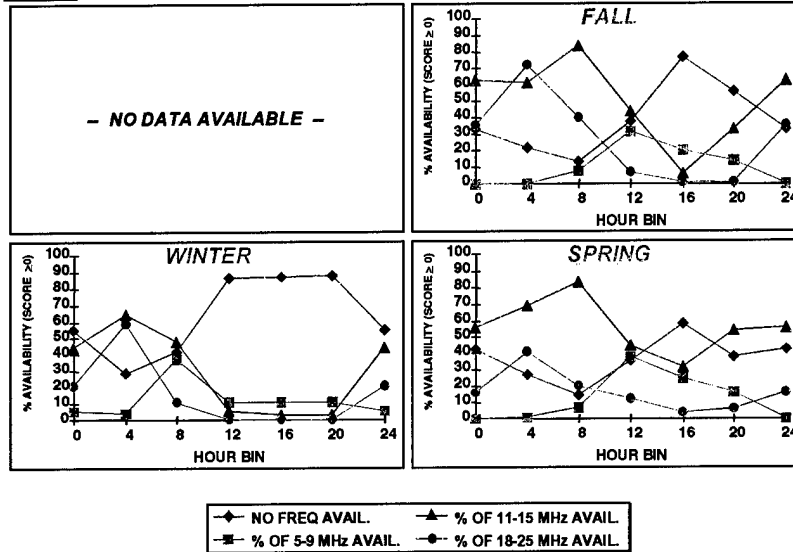


N1810-GA-95(L)0524U.M72

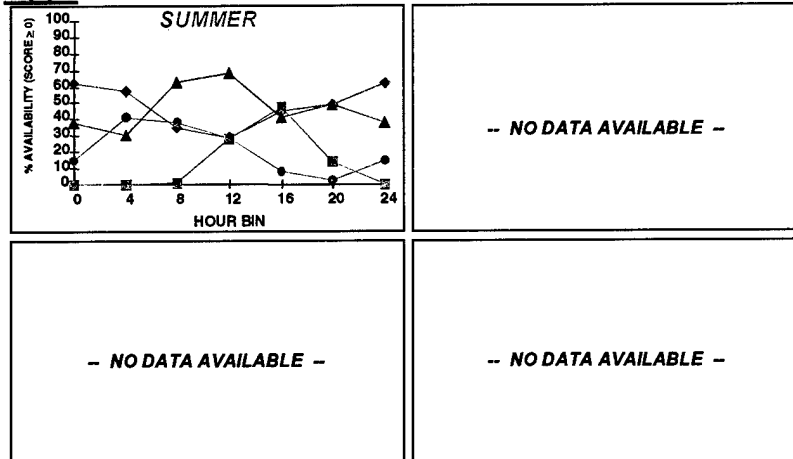
Figure 81. Percent Availability of Each Frequency Group by Season, Salisbury to Christchurch

SALISBURY TO DAVIS

1993



1994

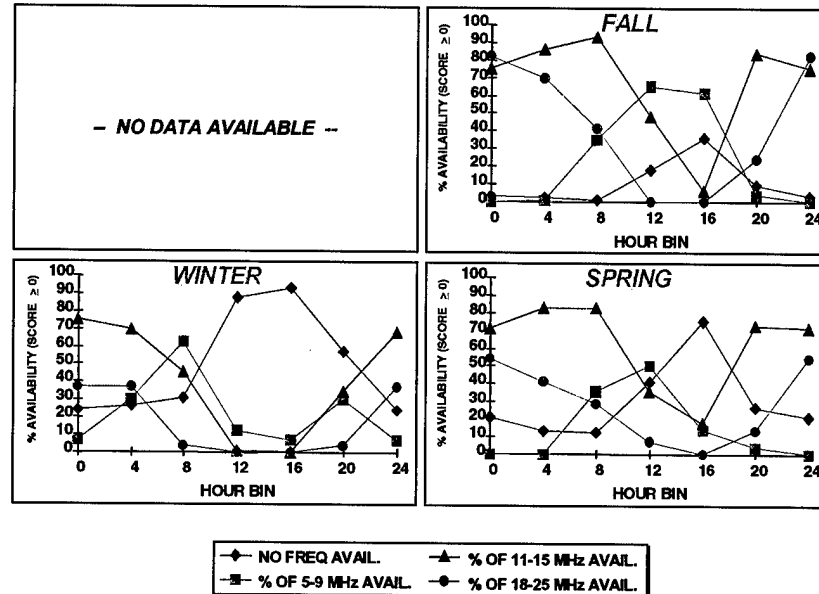


N1810-GA-95(L)0524U.M73

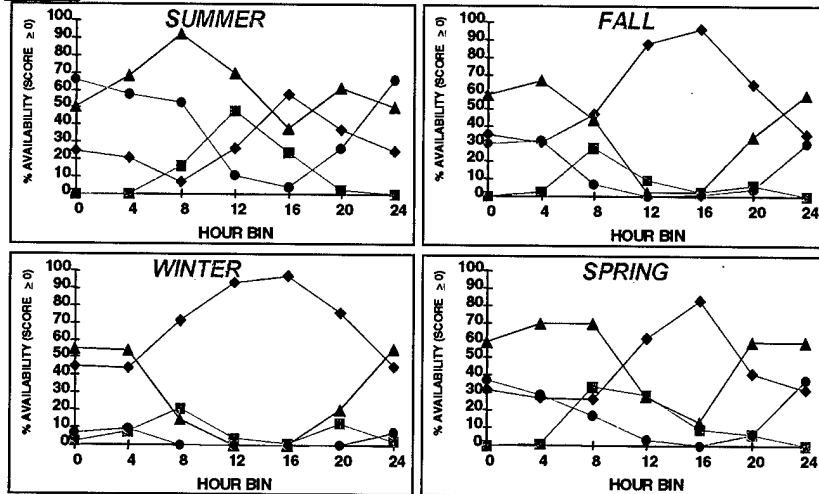
Figure 82. Percent Availability of Each Frequency Group by Season, Salisbury to Davis

SALISBURY TO MCMURDO

1993



1994



N1810-GA-95(L)0524U.M74

Figure 83. Percent Availability of Each Frequency Group by Season, Salisbury to McMurdo

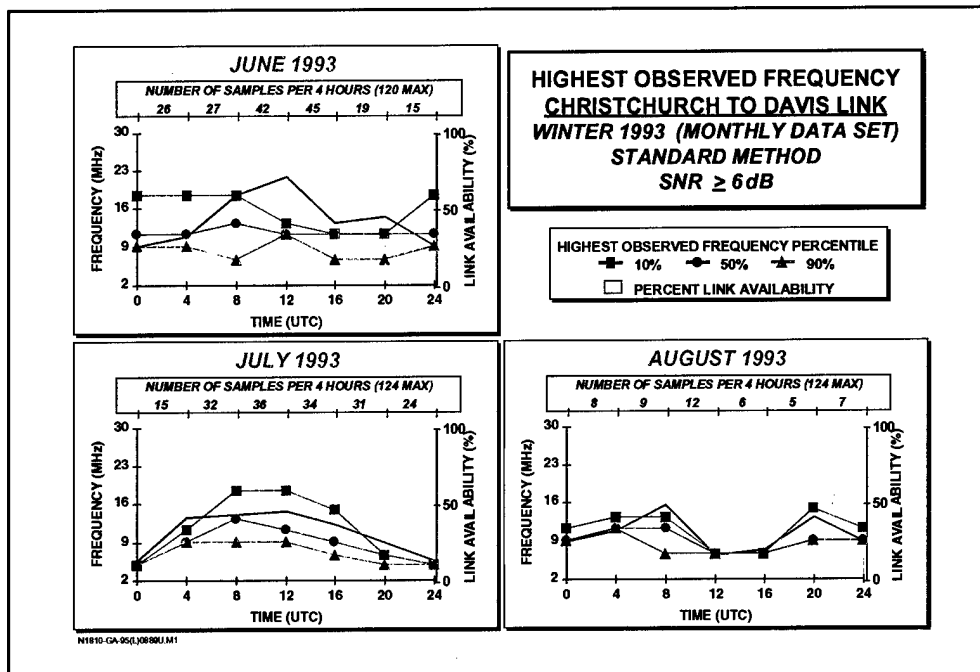


Figure 84. Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-Davis Link by Month, Winter 1993 (6-dB Minimum Measured SINAD)

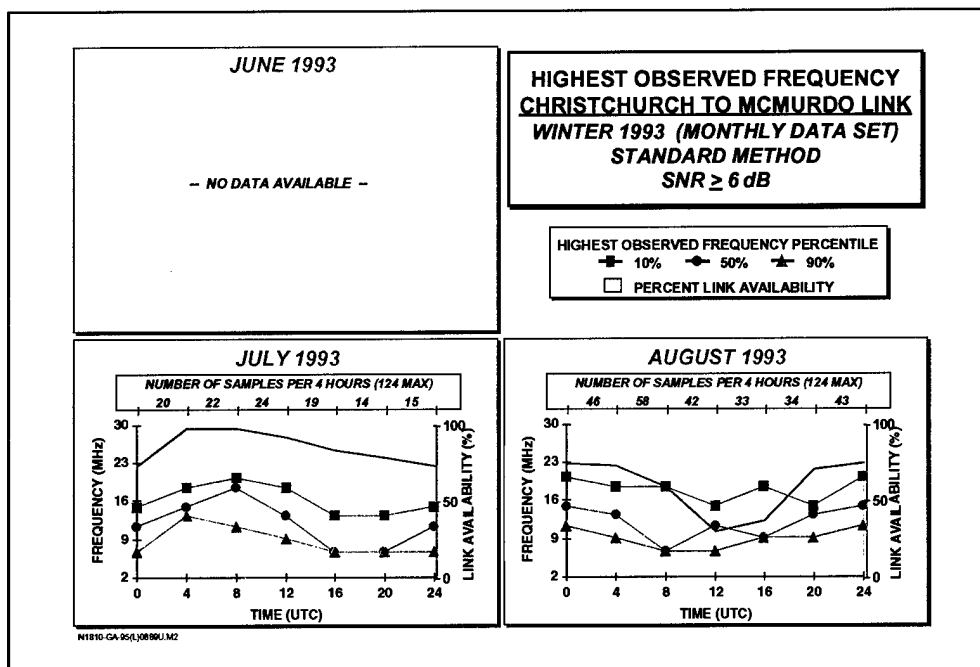


Figure 85. Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-McMurdo Link by Month, Winter 1993 (6-dB Minimum Measured SINAD)

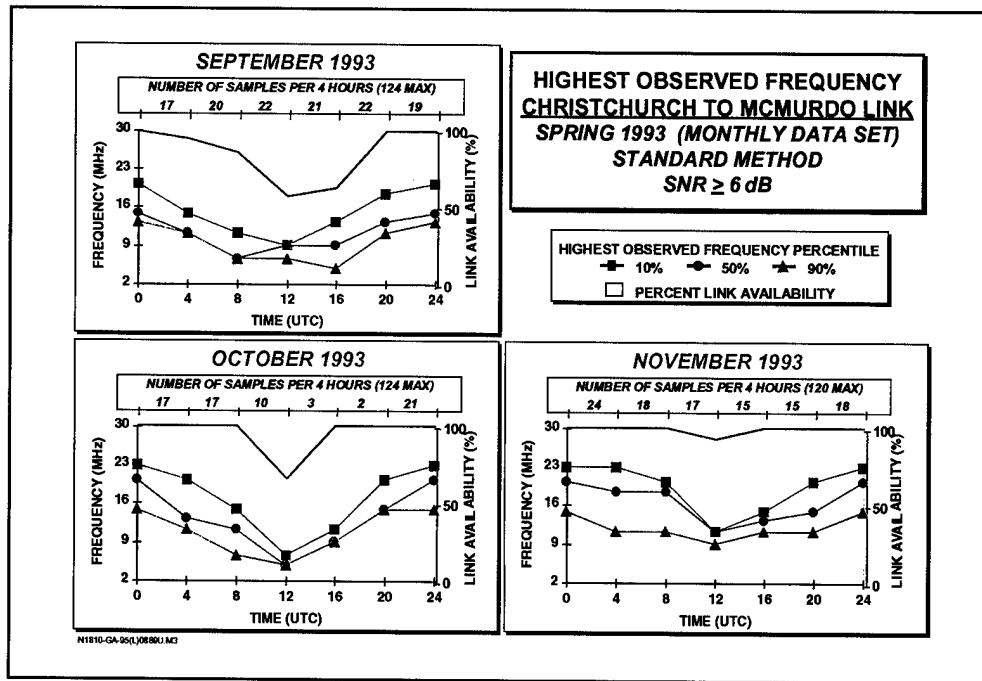


Figure 86. Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-McMurdo Link by Month, Spring 1993 (6-dB Minimum Measured SINAD)

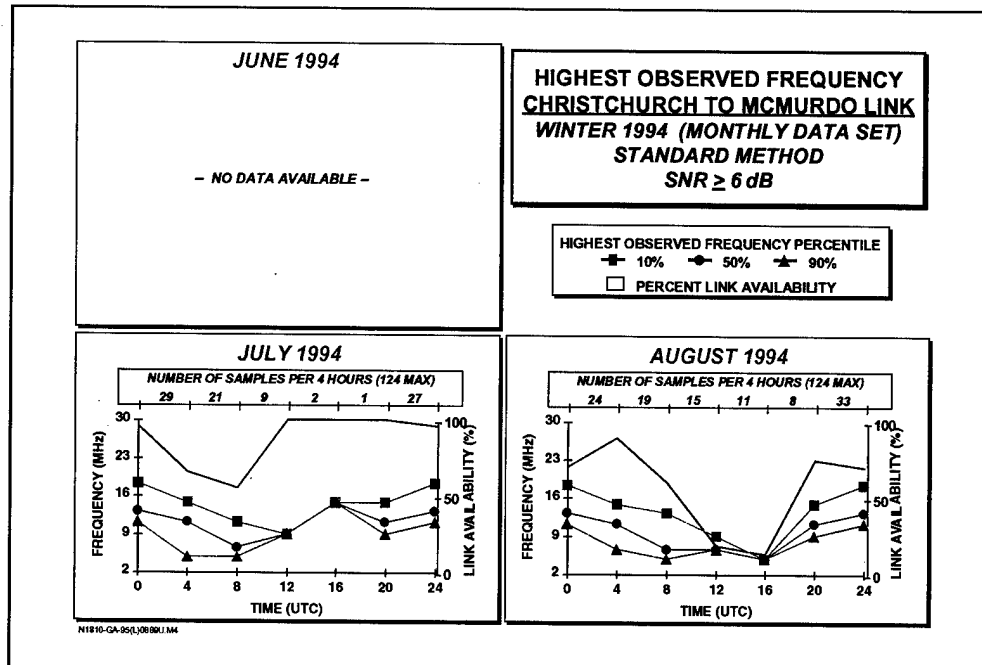


Figure 87. Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-McMurdo Link by Month, Winter 1994 (6-dB Minimum Measured SINAD)

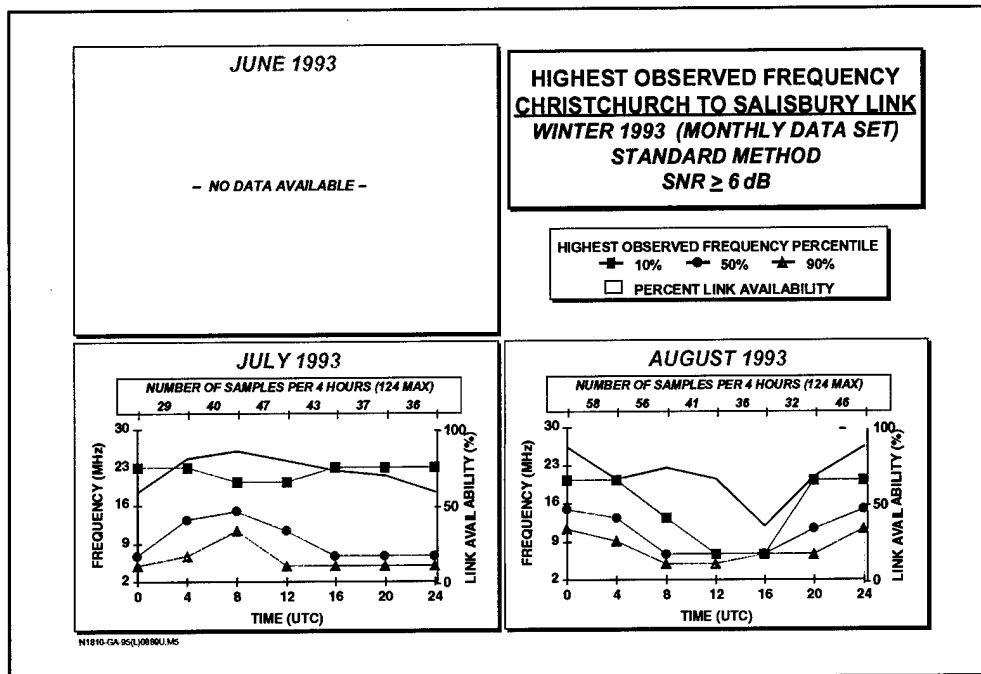


Figure 88. Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-Salisbury Link by Month, Winter 1993 (6-dB Minimum Measured SINAD)

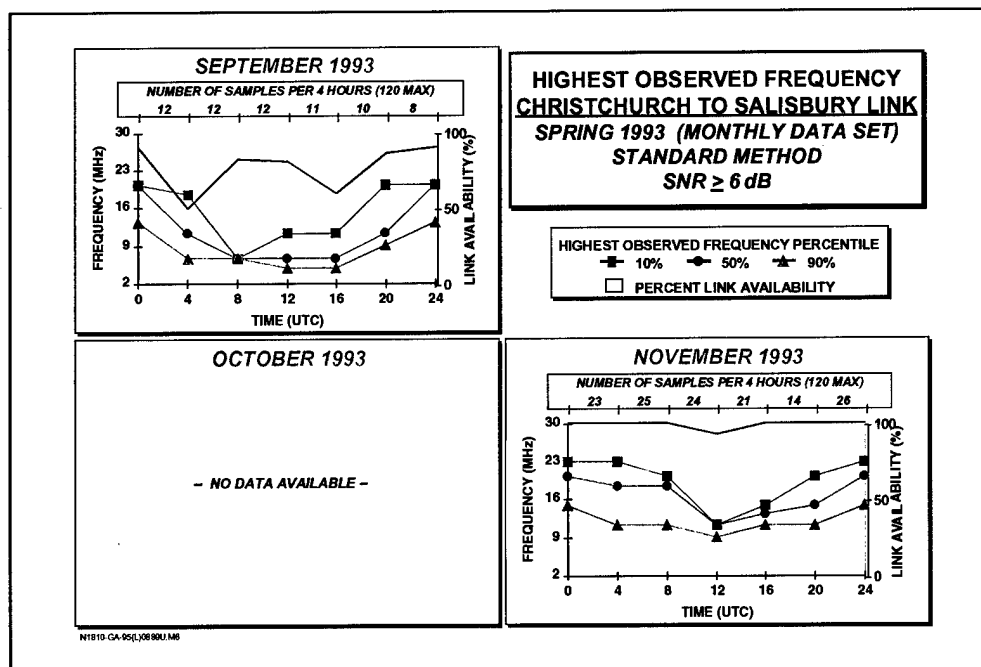


Figure 89. Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-Salisbury Link by Month, Spring 1993 (6-dB Minimum Measured SINAD)

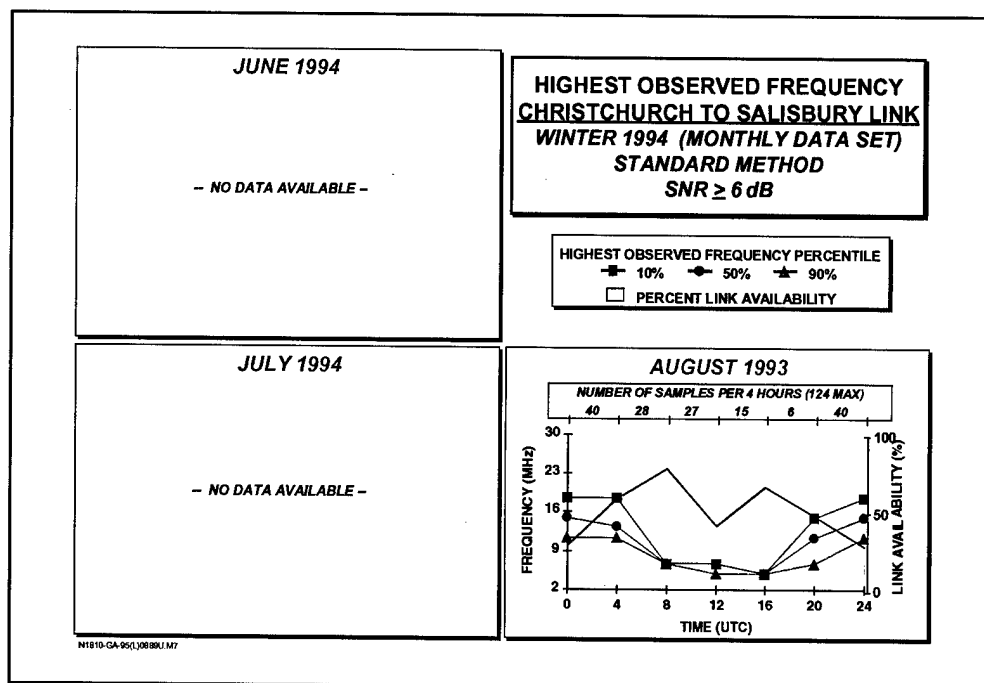


Figure 90. Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-Salisbury Link by Month, Winter 1994 (6-dB Minimum Measured SINAD)

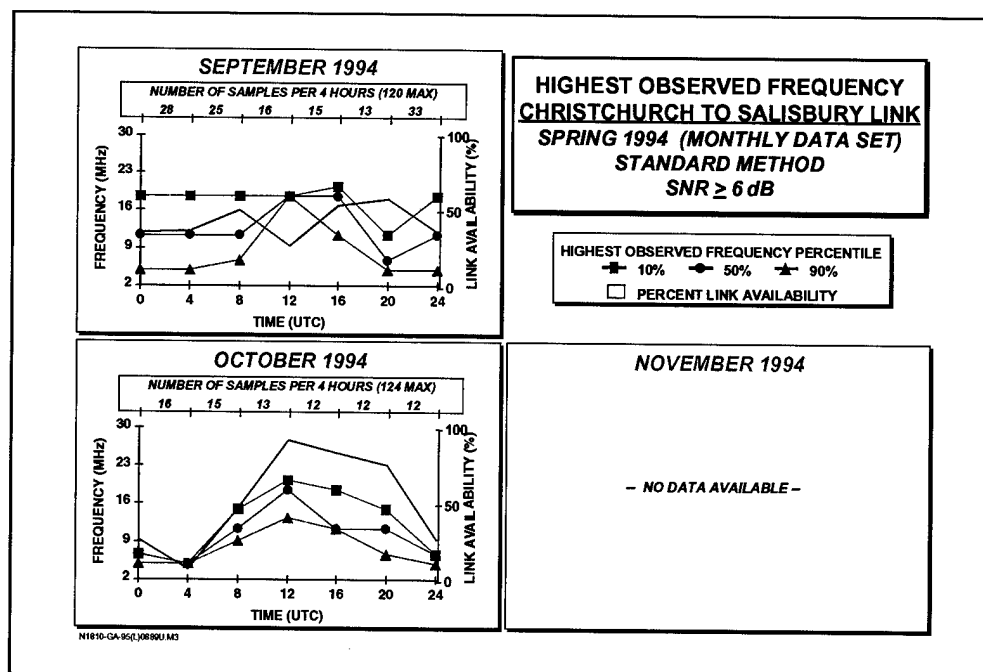
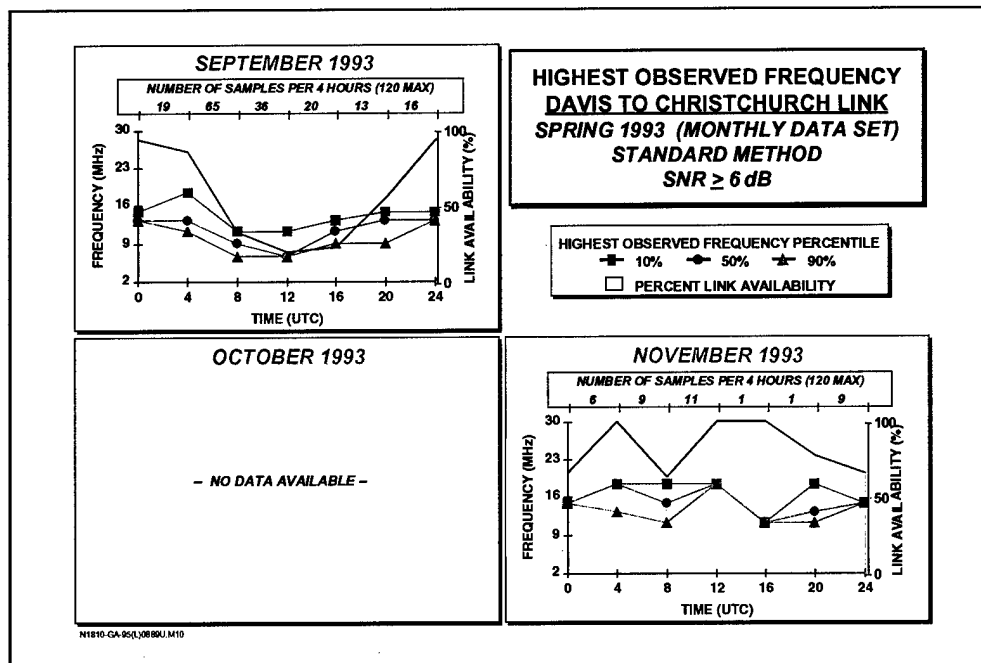
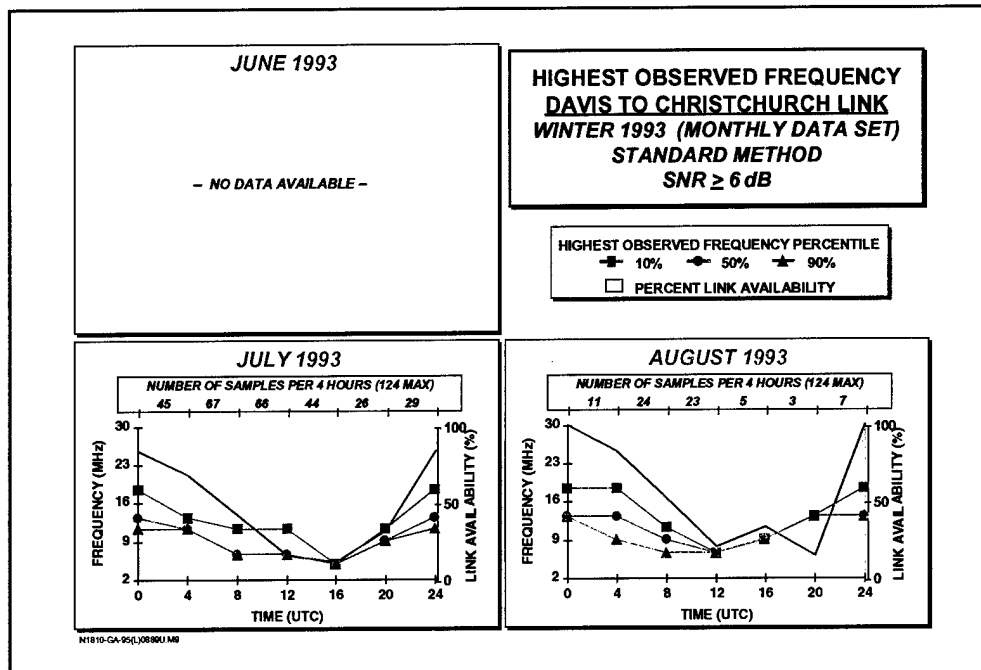


Figure 91. Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-Salisbury Link by Month, Spring 1994 (6-dB Minimum Measured SINAD)



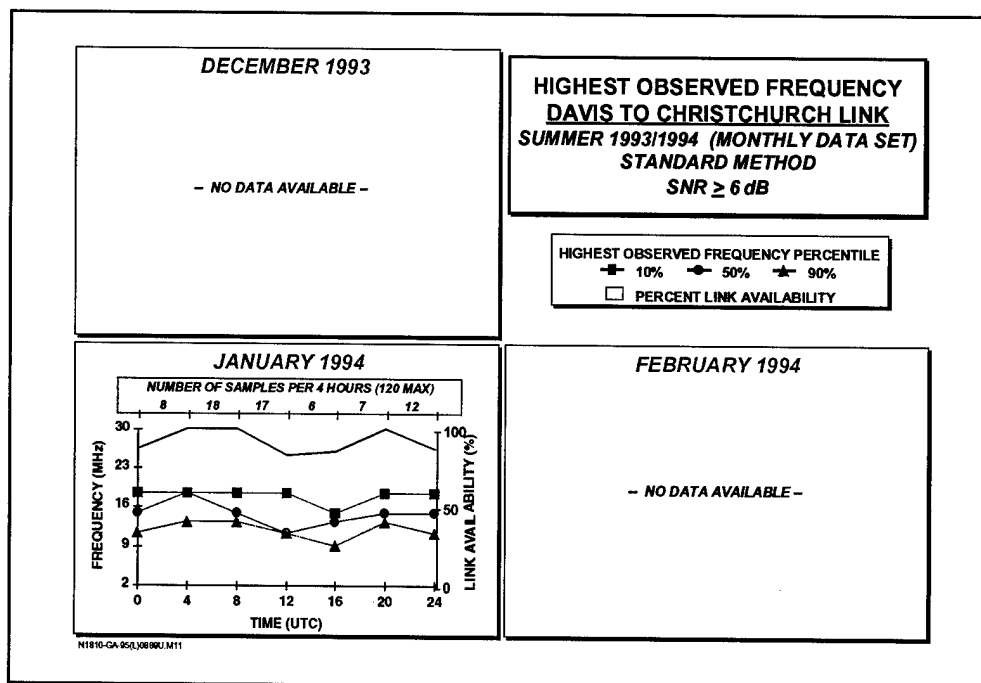


Figure 94. Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-Christchurch Link by Month, Summer/Winter 1993 (6-dB Minimum Measured SINAD)

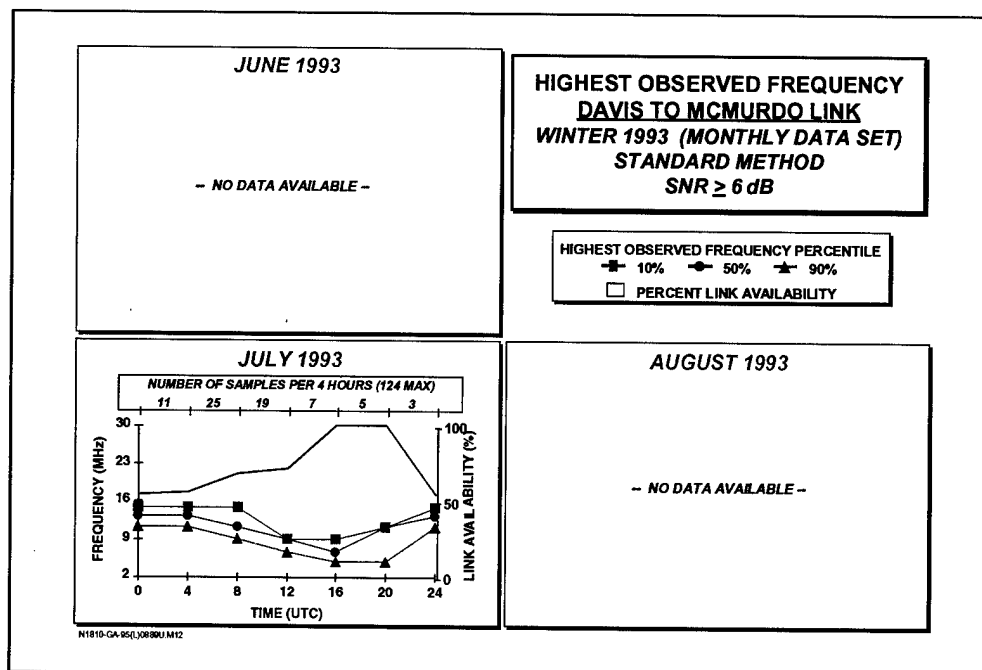


Figure 95. Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-McMurdo Link by Month, Winter 1993 (6-dB Minimum Measured SINAD)

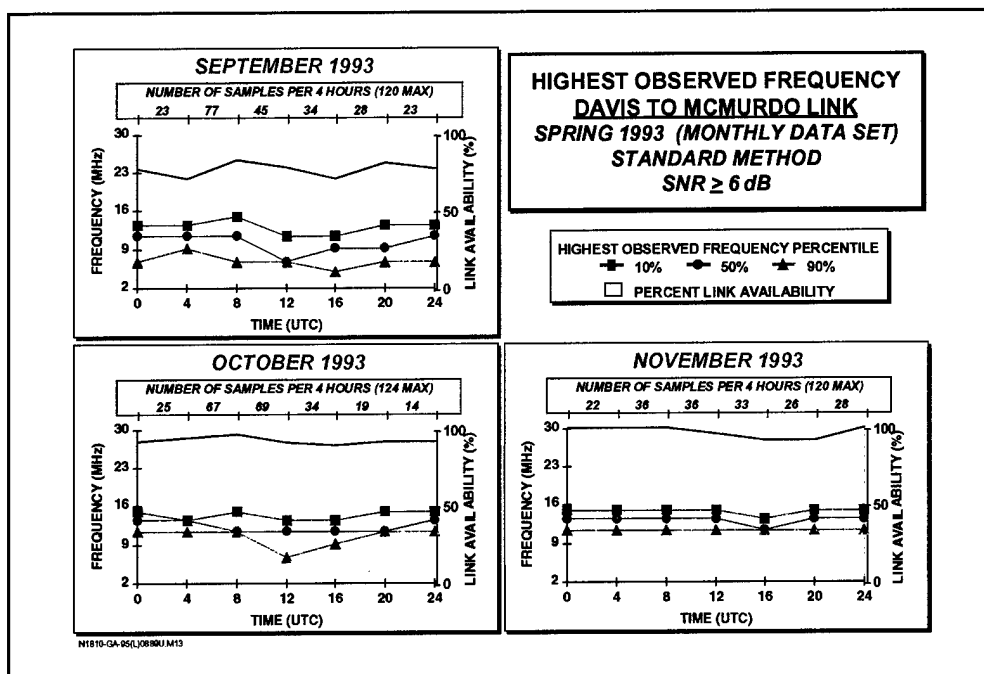


Figure 96. Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-McMurdo Link by Month, Spring 1993 (6-dB Minimum Measured SINAD)

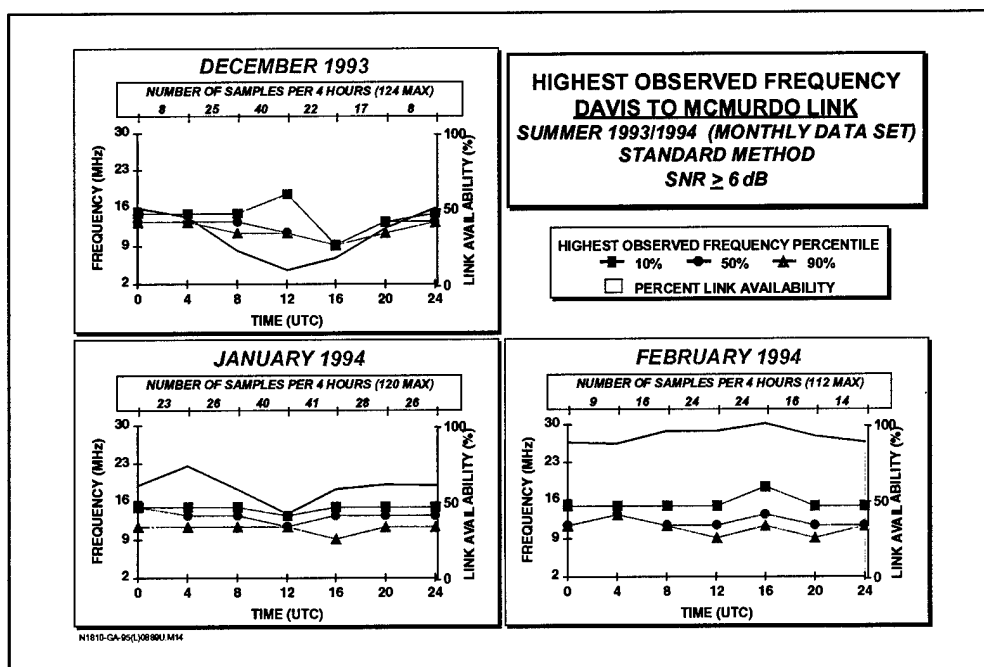


Figure 97. Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-McMurdo Link by Month, Summer 1993/1994 (6-dB Minimum Measured SINAD)

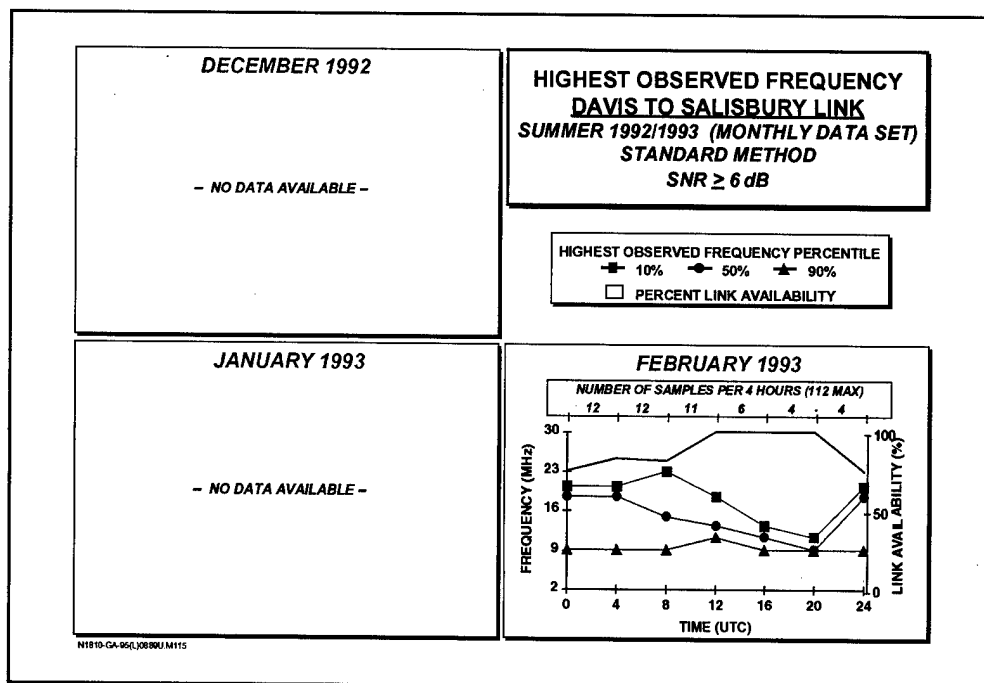


Figure 98. Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-Salisbury Link by Month, Summer 1992/1993 (6-dB Minimum Measured SINAD)

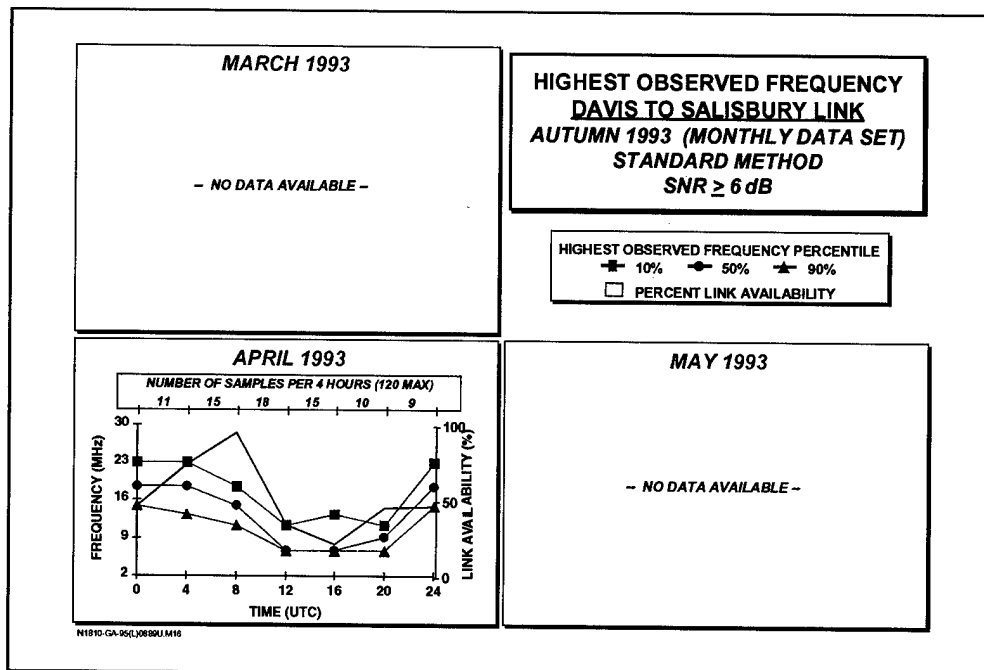


Figure 99. Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-Salisbury Link by Month, Fall 1993 (6-dB Minimum Measured SINAD)

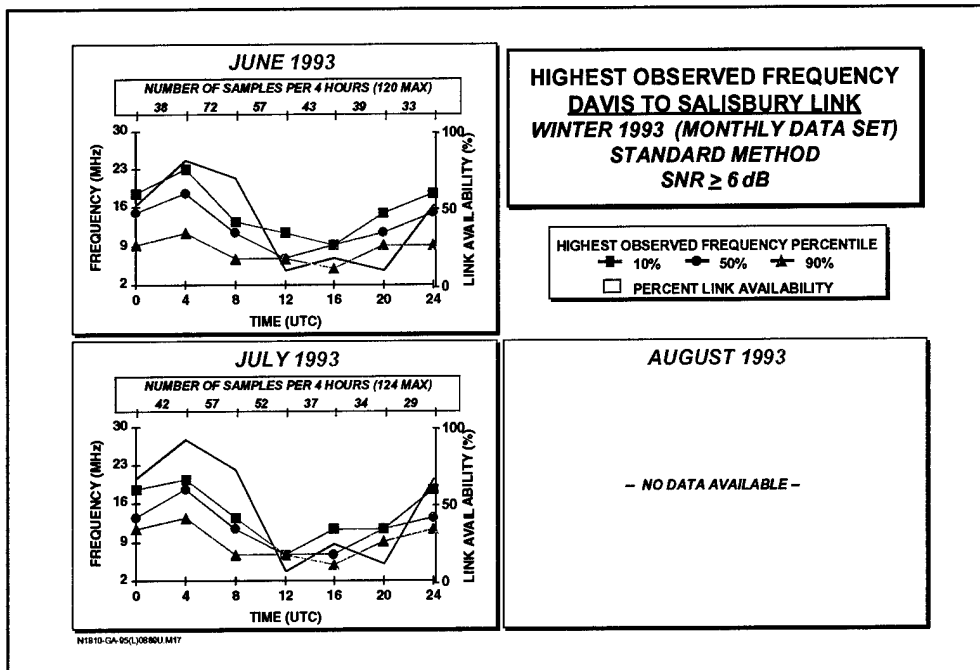


Figure 100. Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-Salisbury Link by Month, Winter 1993 (6-dB Minimum Measured SINAD)

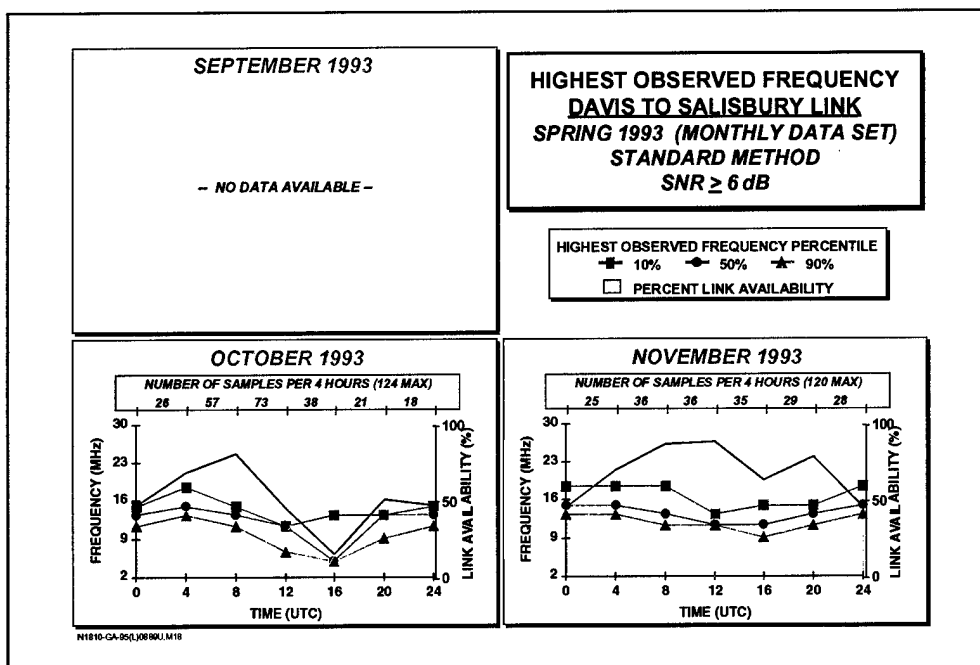


Figure 101. Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-Salisbury Link by Month, Spring 1993 (6-dB Minimum Measured SINAD)

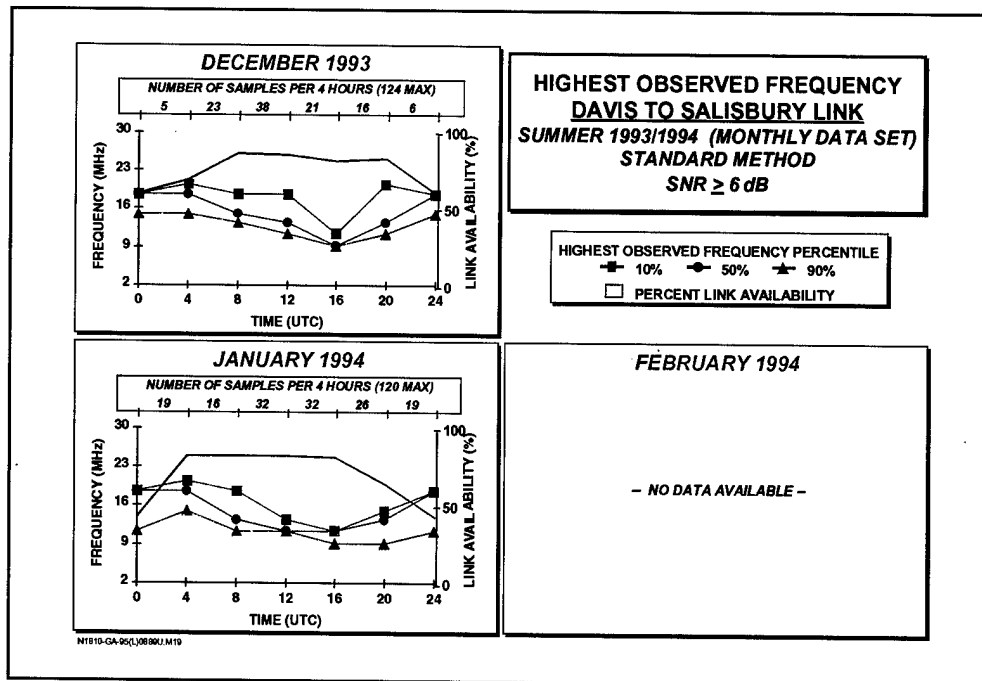


Figure 102. Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-Salisbury Link by Month, Summer 1993/1994 (6-dB Minimum Measured SINAD)

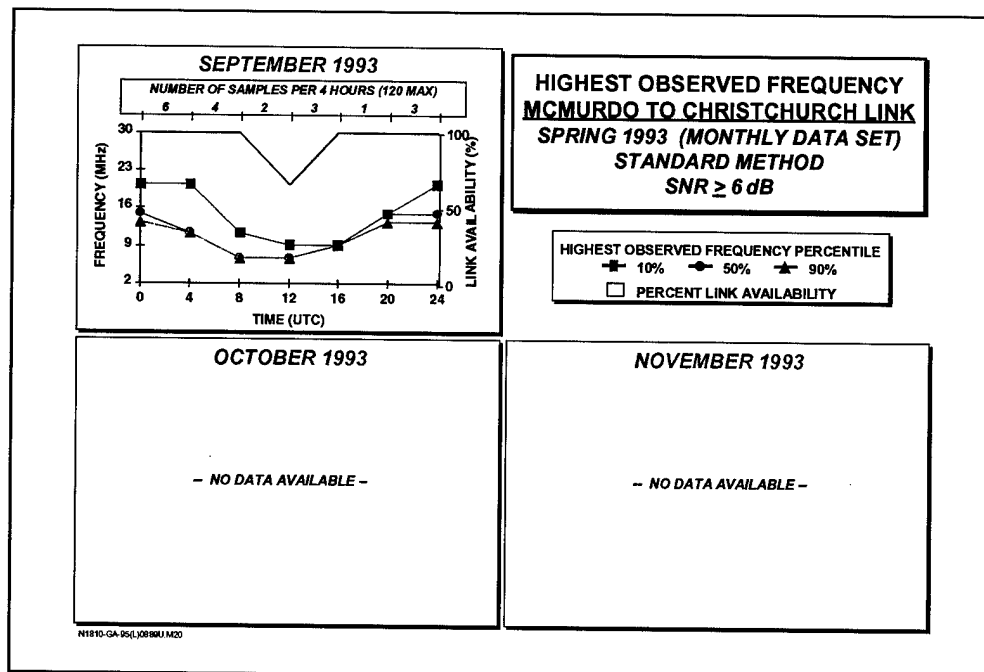


Figure 103. Exceedance (90%, 50%, and 10%) for Best Frequency, McMurdo-to-Christchurch Link by Month, Spring 1993 (6-dB Minimum Measured SINAD)

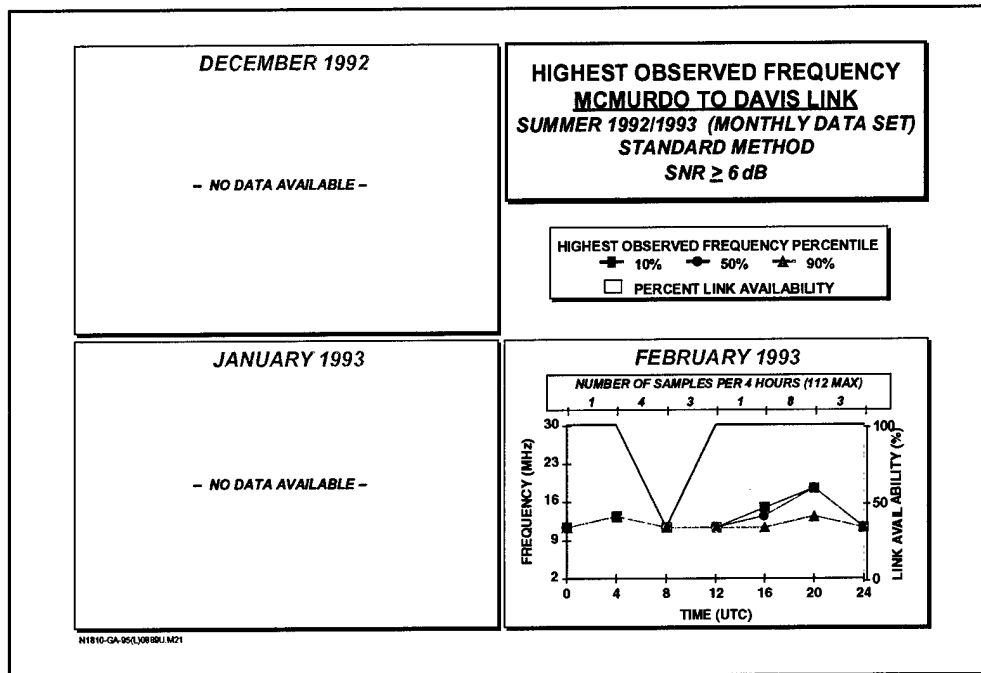


Figure 104. Exceedance (90%, 50%, and 10%) for Best Frequency, McMurdo-to-Davis Link by Month, Summer 1992/1993 (6-dB Minimum Measured SINAD)

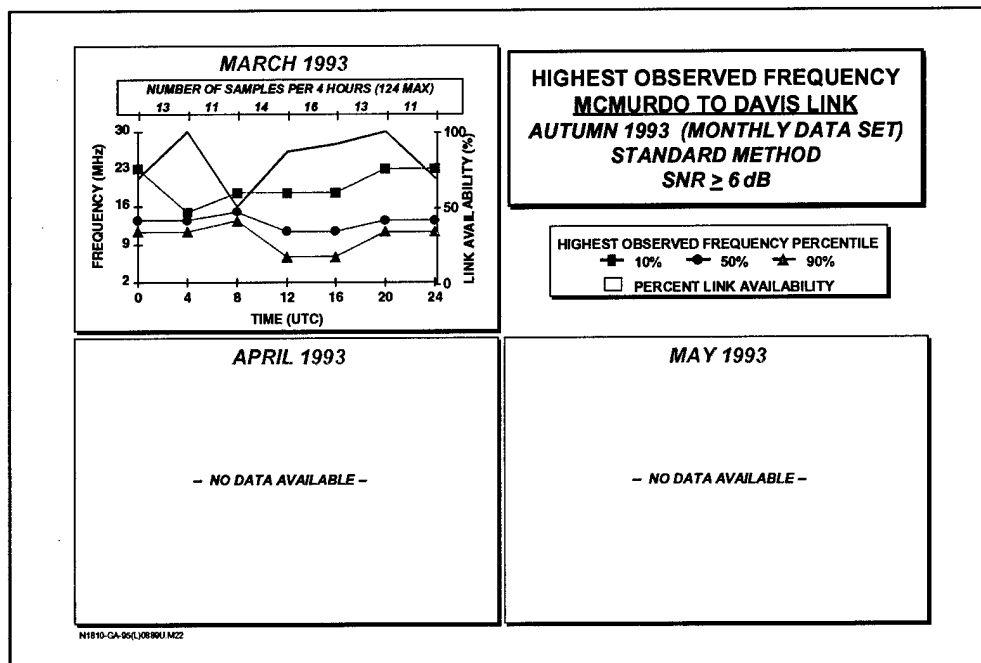


Figure 105. Exceedance (90%, 50%, and 10%) for Best Frequency, McMurdo-to-Davis Link by Month, Fall 1993 (6-dB Minimum Measured SINAD)

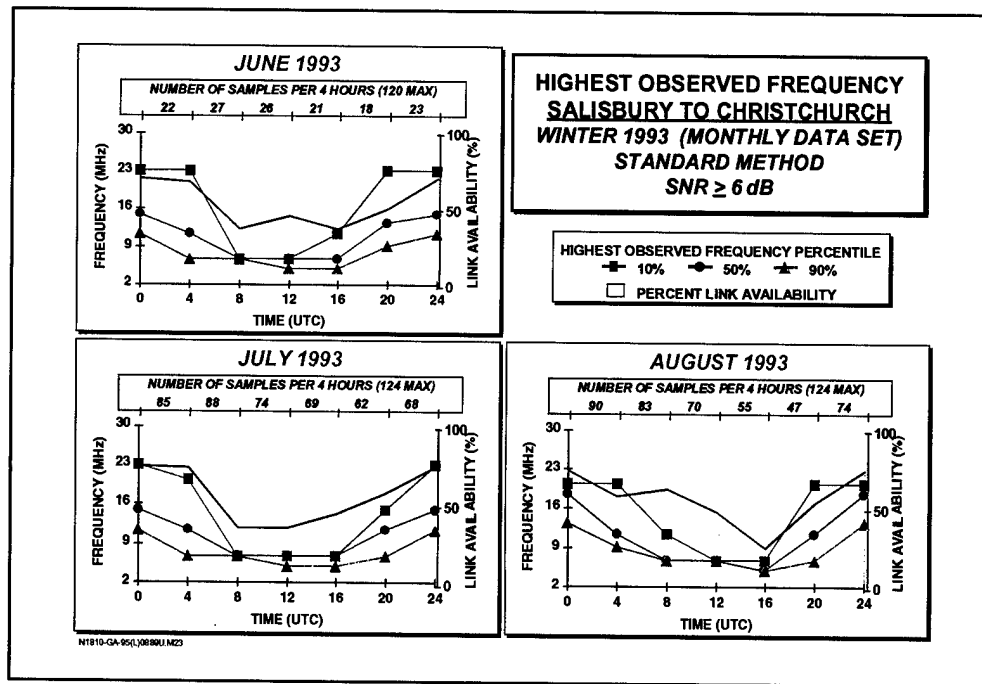


Figure 106. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Christchurch Link by Month, Winter 1993 (6-dB Minimum Measured SINAD)

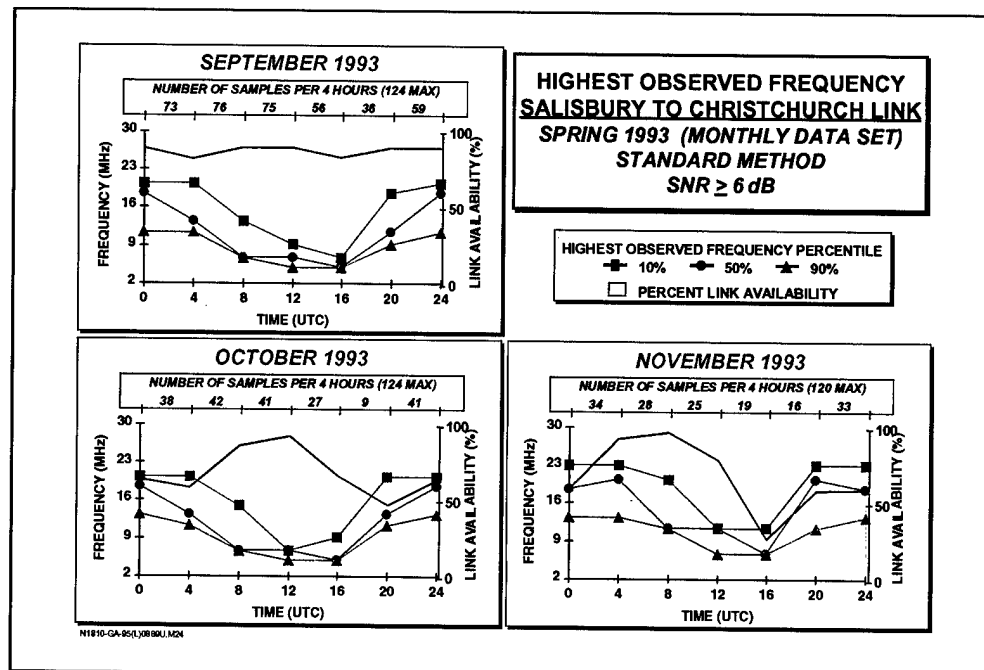


Figure 107. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Christchurch Link by Month, Spring 1993 (6-dB Minimum Measured SINAD)

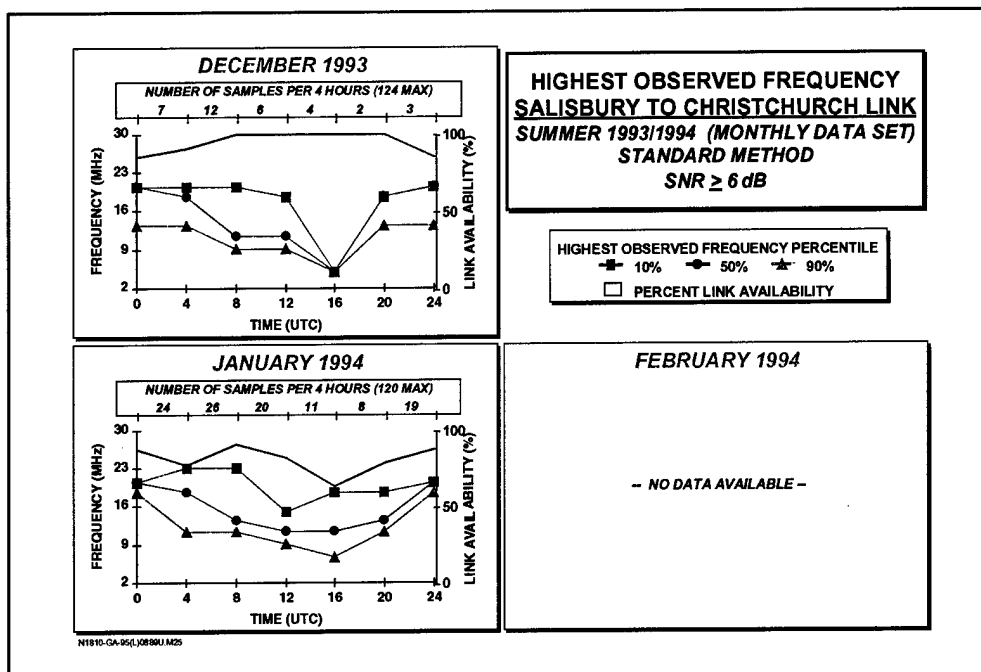


Figure 108. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Christchurch Link by Month, Summer 1993/1994 (6-dB Minimum Measured SINAD)

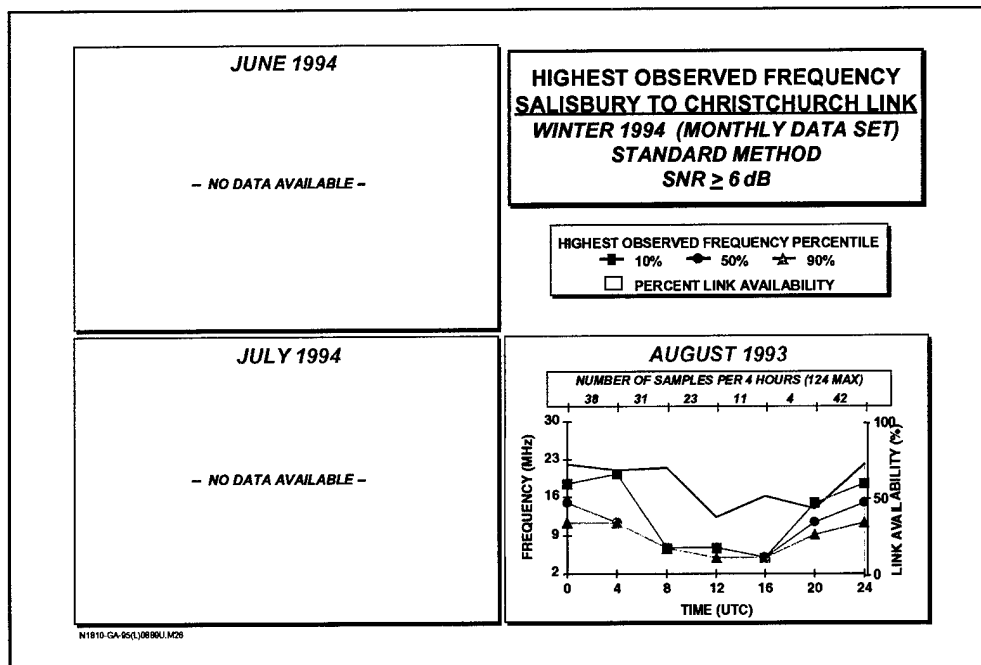


Figure 109. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Christchurch Link by Month, Winter 1994 (6-dB Minimum Measured SINAD)

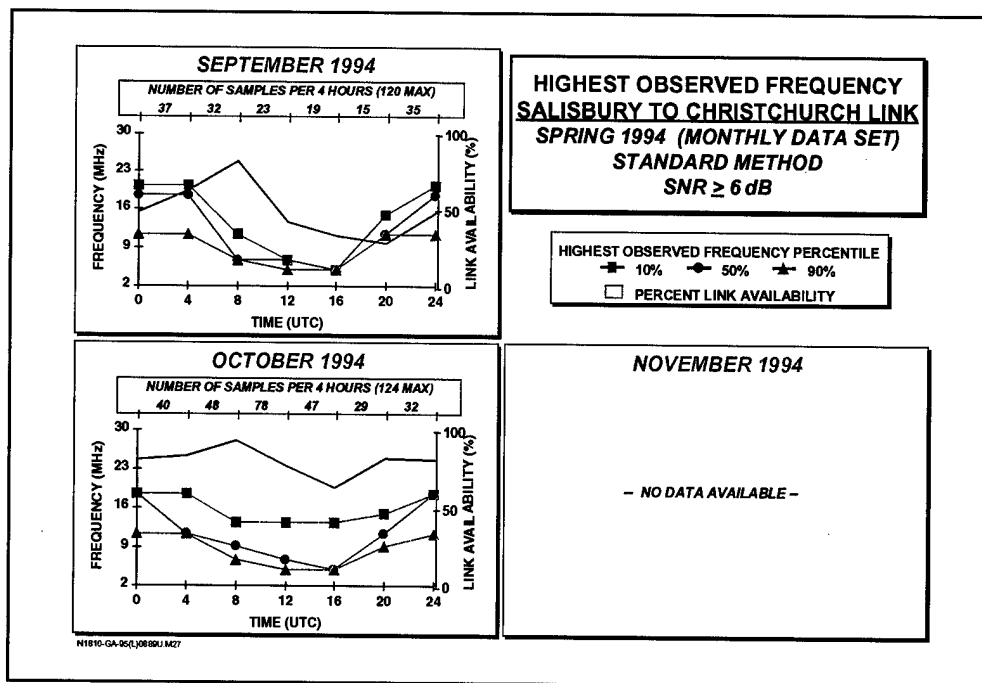


Figure 110 Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Christchurch Link by Month, Spring 1994 (6-dB Minimum Measured SINAD)

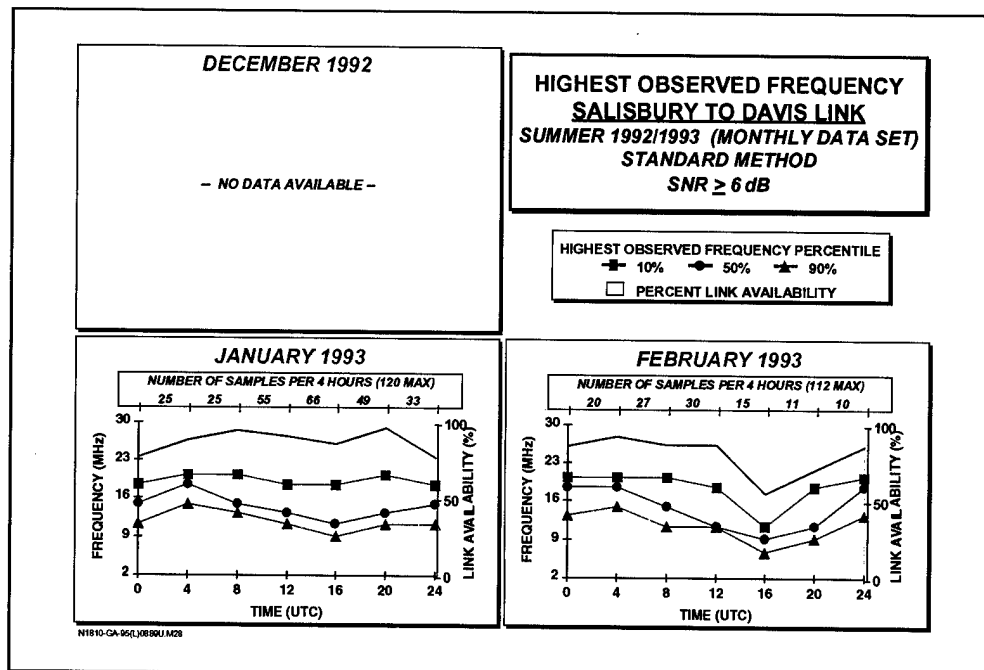


Figure 111. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Davis Link by Month, Summer 1992/1993 (6-dB Minimum Measured SINAD)

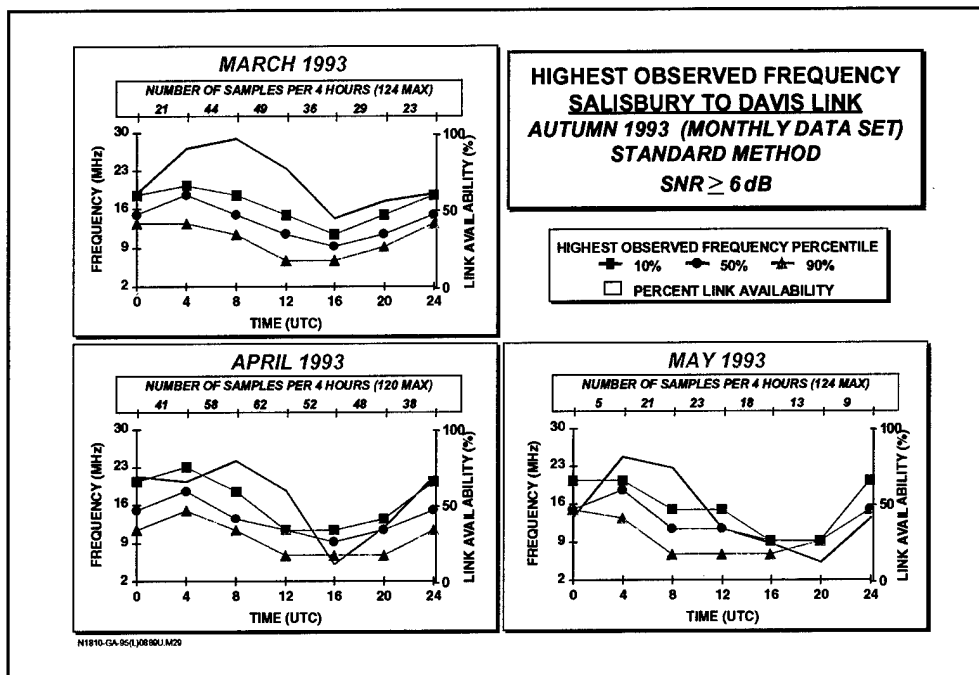


Figure 112. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Davis Link by Month, Fall 1993 (6-dB Minimum Measured SINAD)

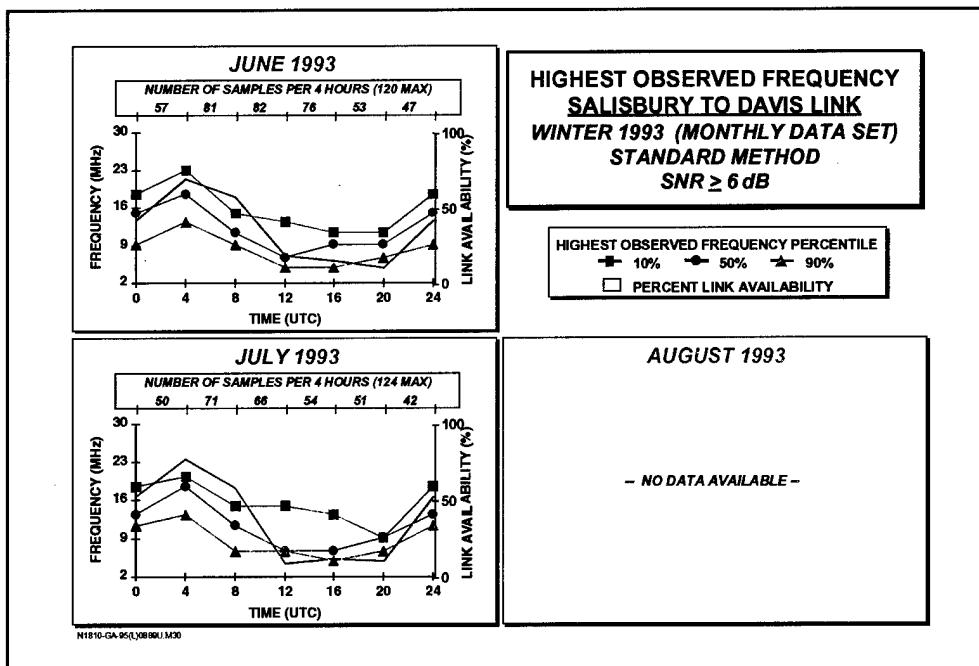


Figure 113. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Davis Link by Month, Winter 1993 (6-dB Minimum Measured SINAD)

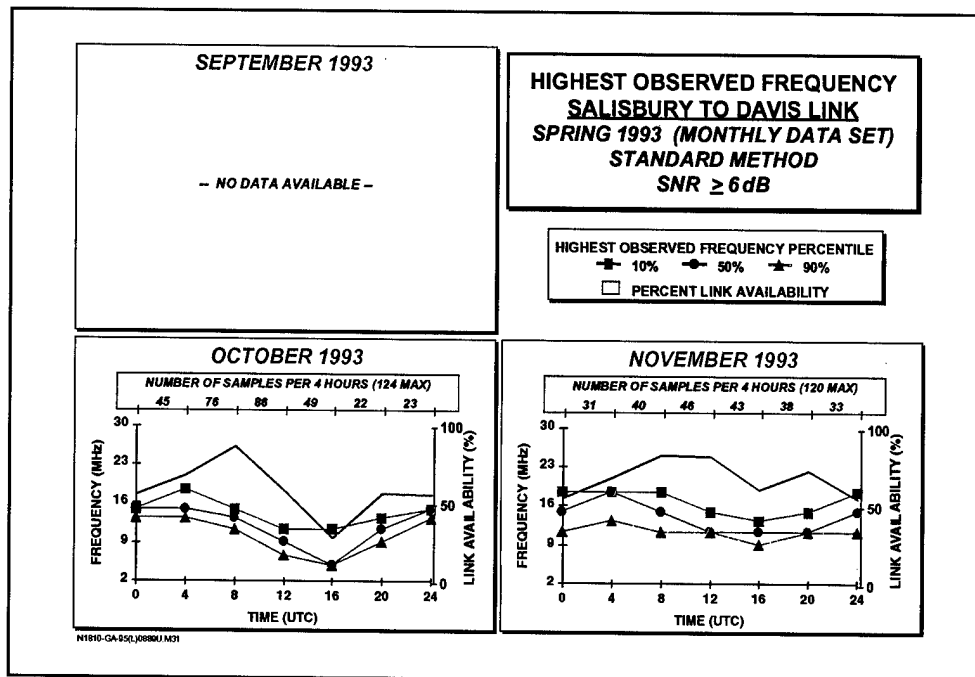


Figure 114. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Davis Link by Month, Spring 1993 (6-dB Minimum Measured SINAD)

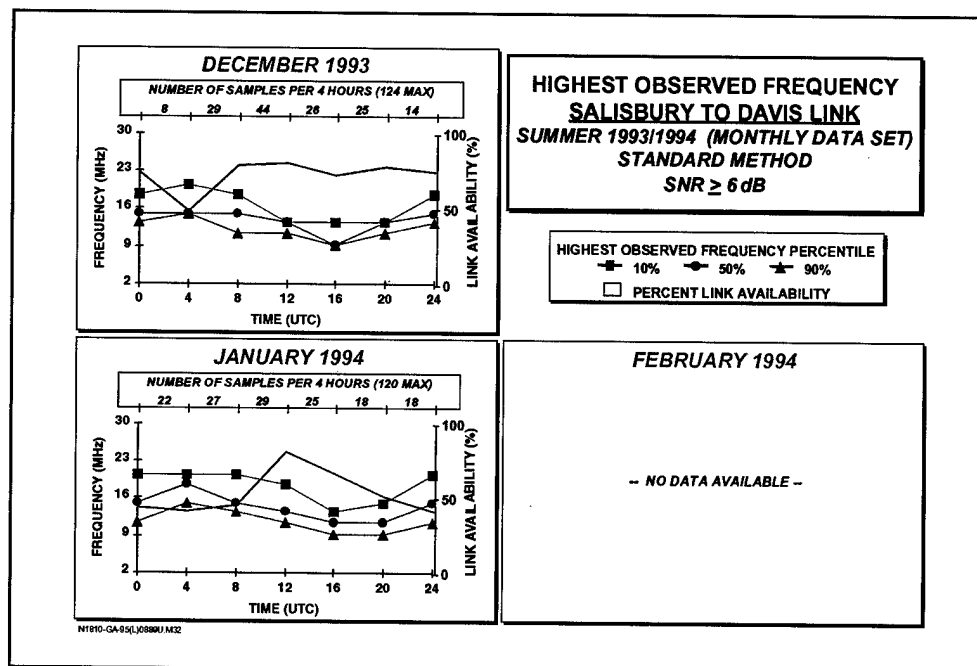


Figure 115. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Davis Link by Month, Summer 1993/1994 (6-dB Minimum Measured SINAD)

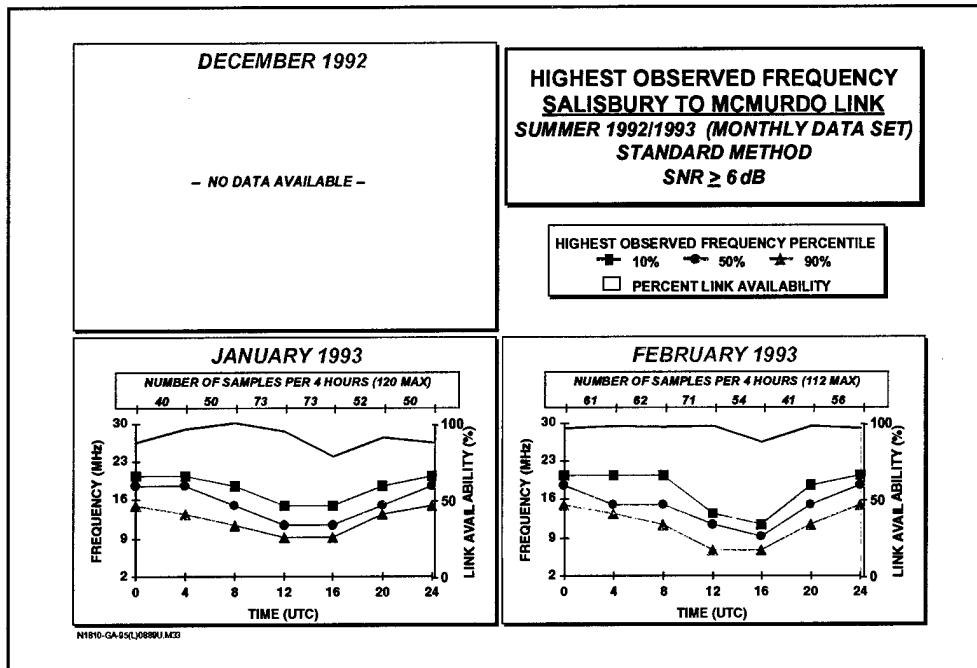


Figure 116. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Month, Summer 1992/1993 (6-dB Minimum Measured SINAD)

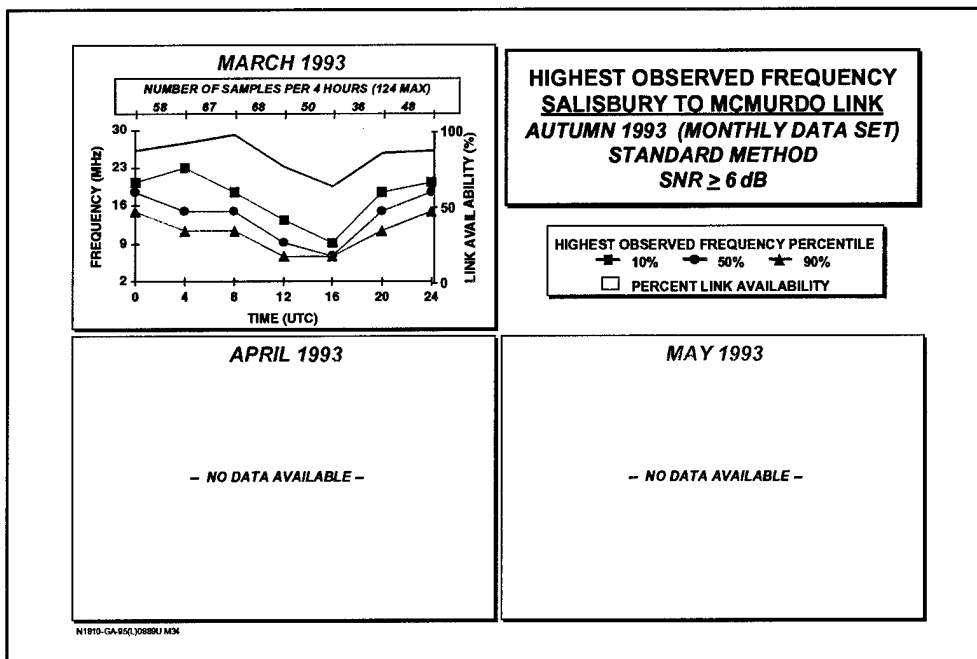


Figure 117. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Month, Fall 1993 (6-dB Minimum Measured SINAD)

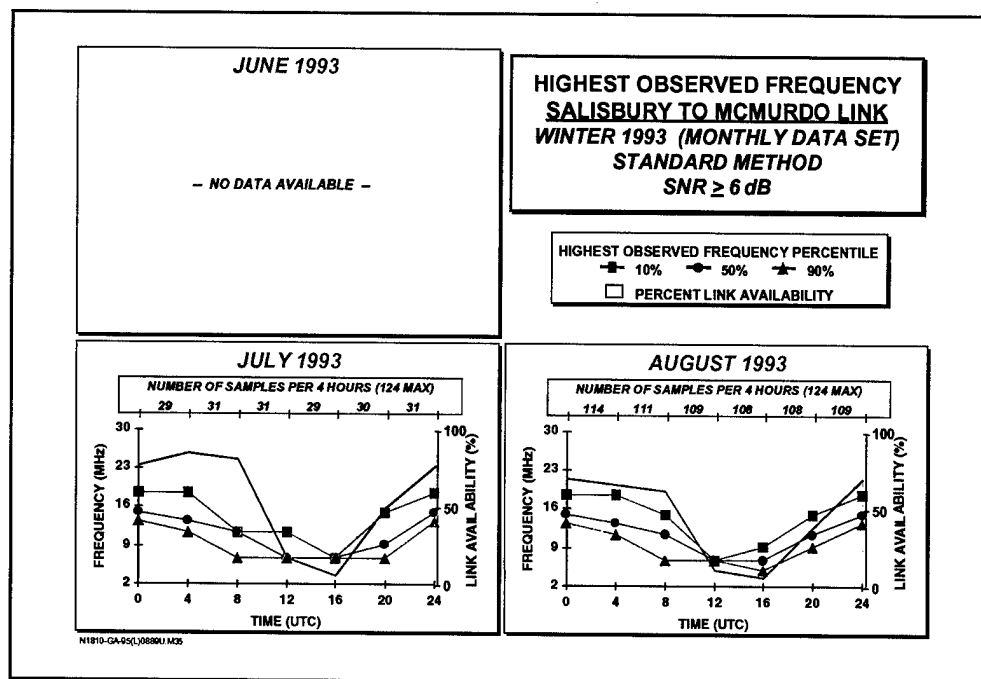


Figure 118. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Month, Winter 1993 (6-dB Minimum Measured SINAD)

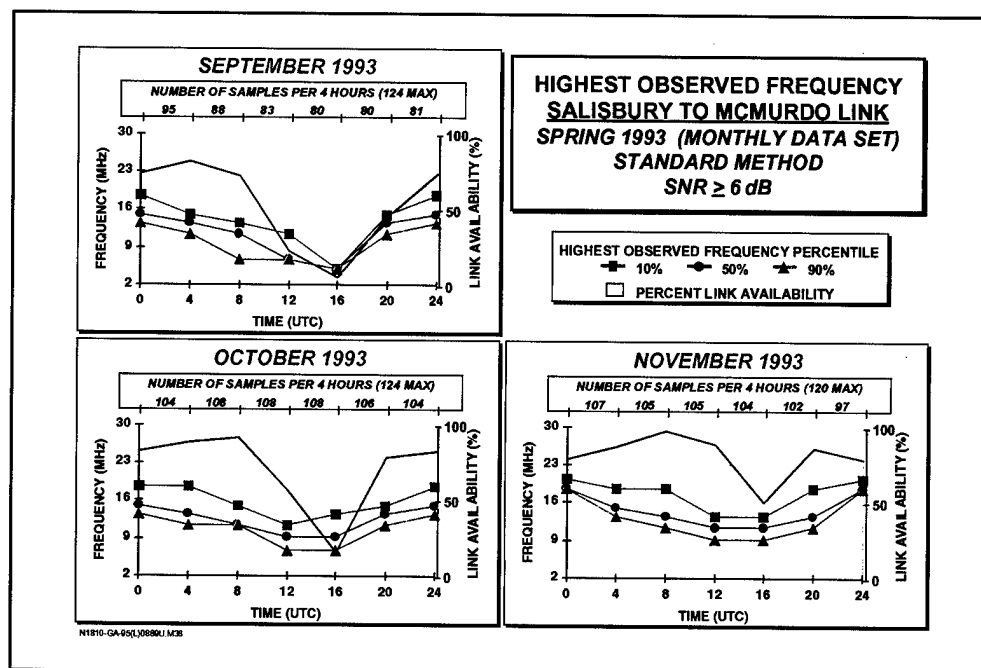


Figure 119. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Month, Spring 1993 (6-dB Minimum Measured SINAD)

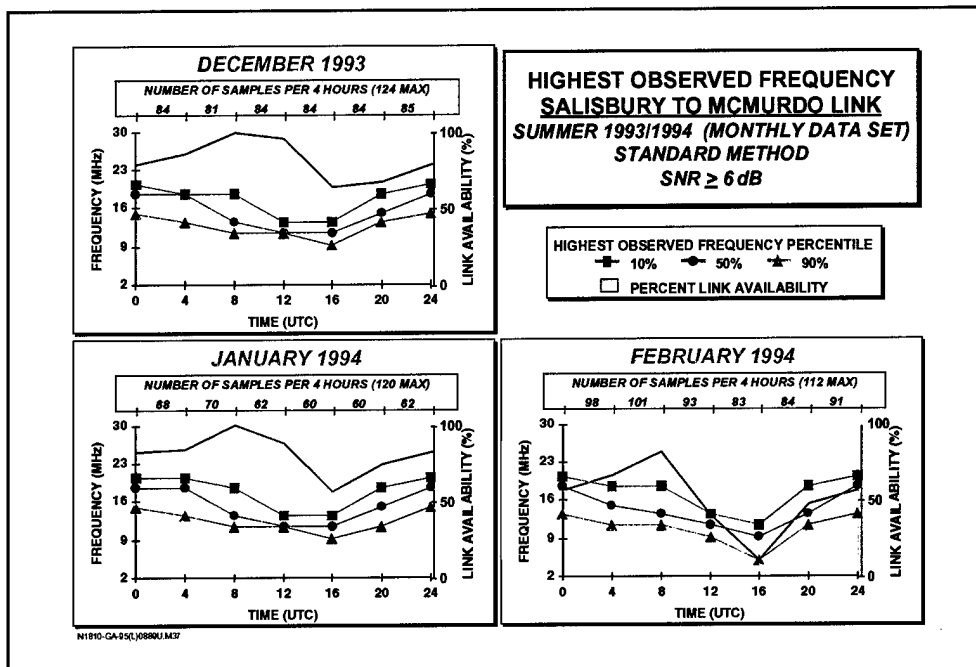


Figure 120. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Month, Summer 1993/1994 (6-dB Minimum Measured SINAD)

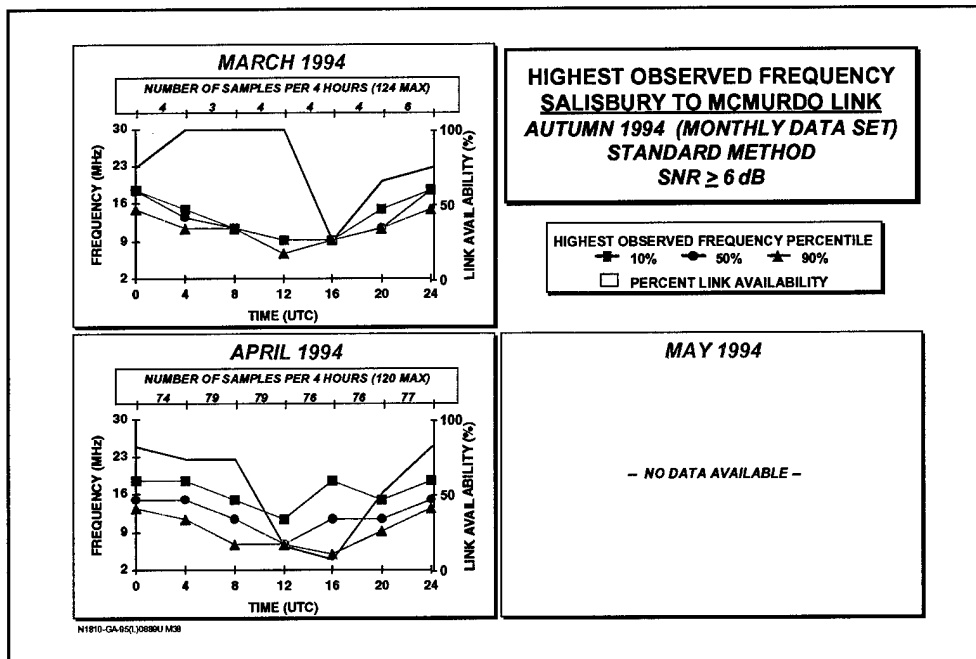


Figure 121. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Month, Fall 1994 (6-dB Minimum Measured SINAD)

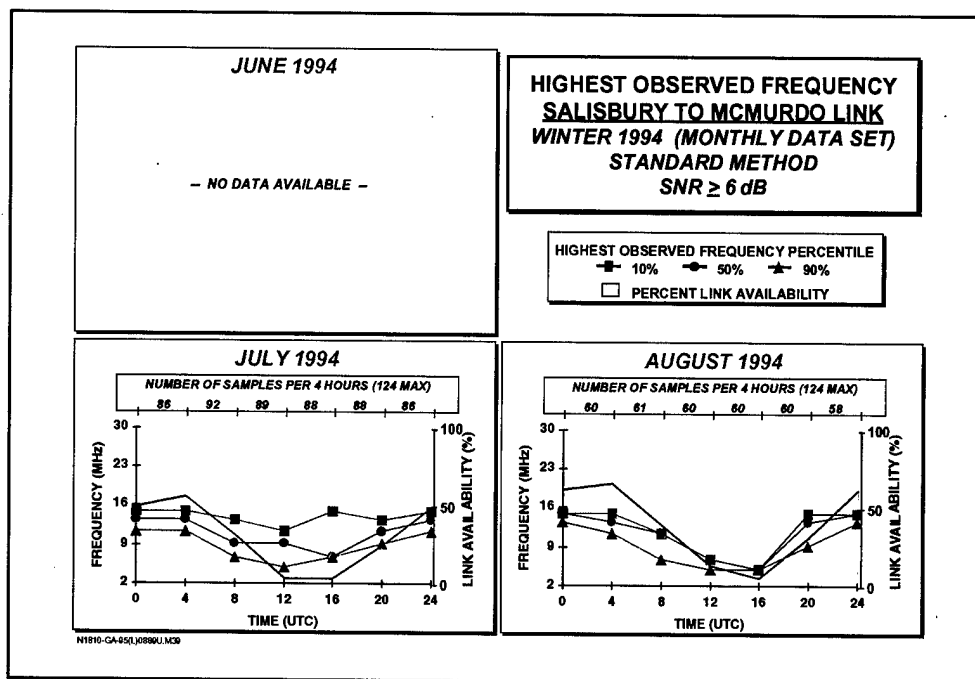


Figure 122. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Month, Winter 1994 (6-dB Minimum Measured SINAD)

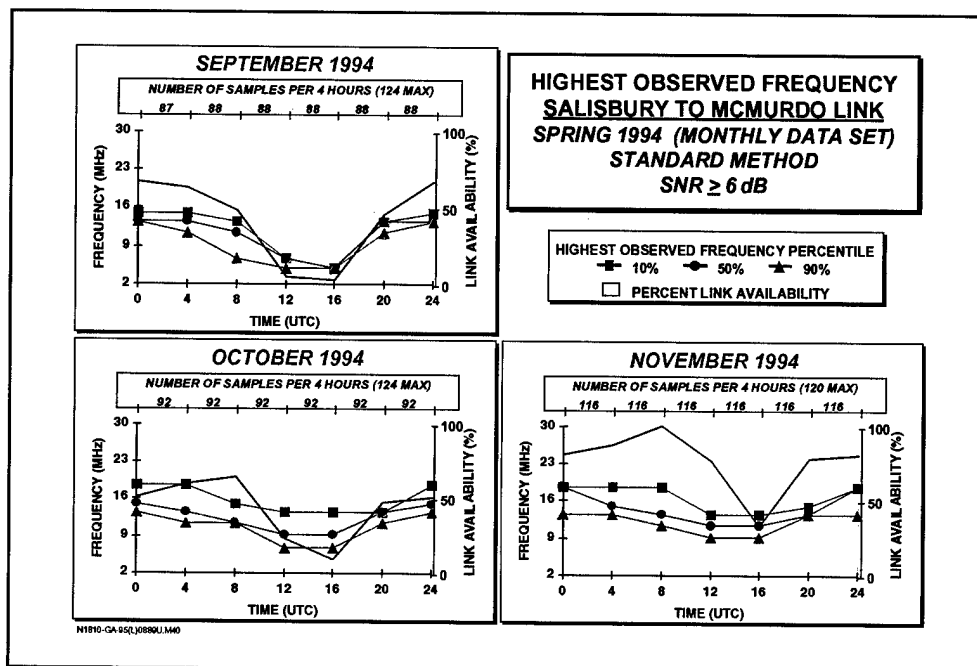


Figure 123. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Month, Spring 1994 (6-dB Minimum Measured SINAD)

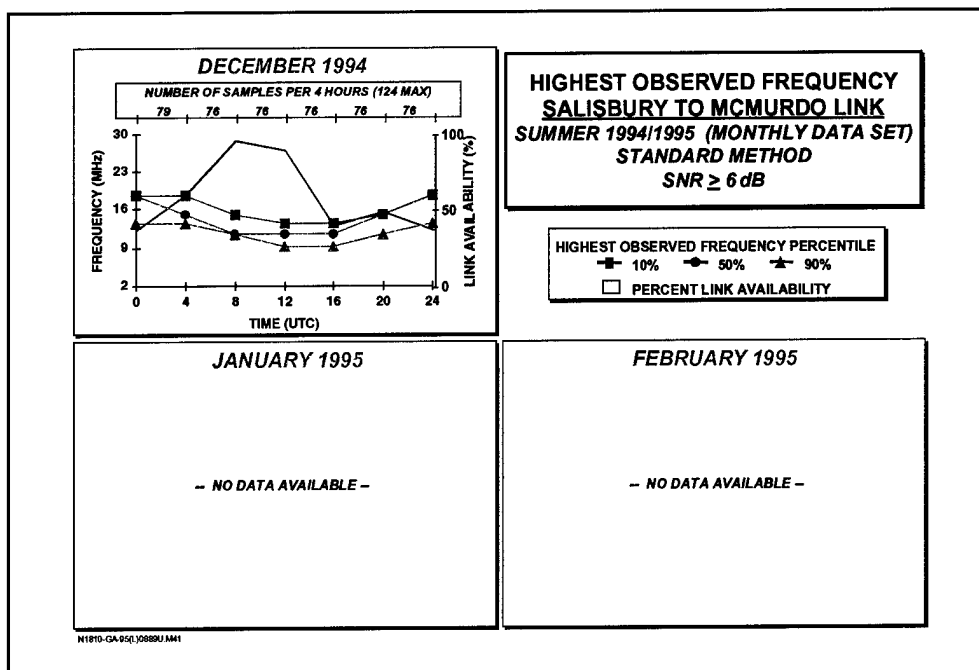


Figure 124. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Month, Summer 1994/1995 (6-dB Minimum Measured SINAD)

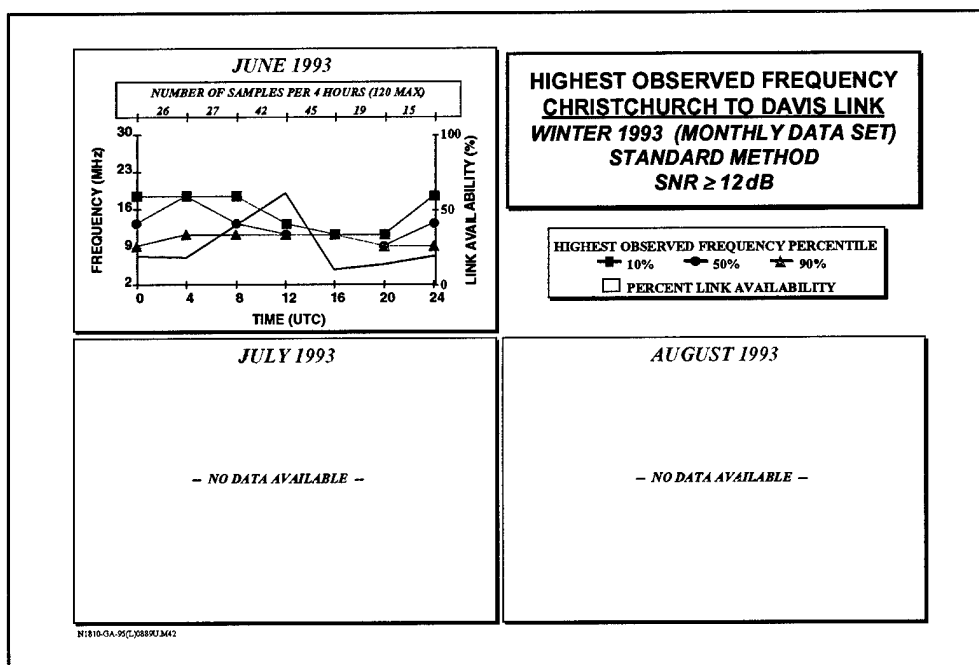


Figure 125. Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-Davis Link by Month, Winter 1993 (12-dB Minimum Measured SINAD)

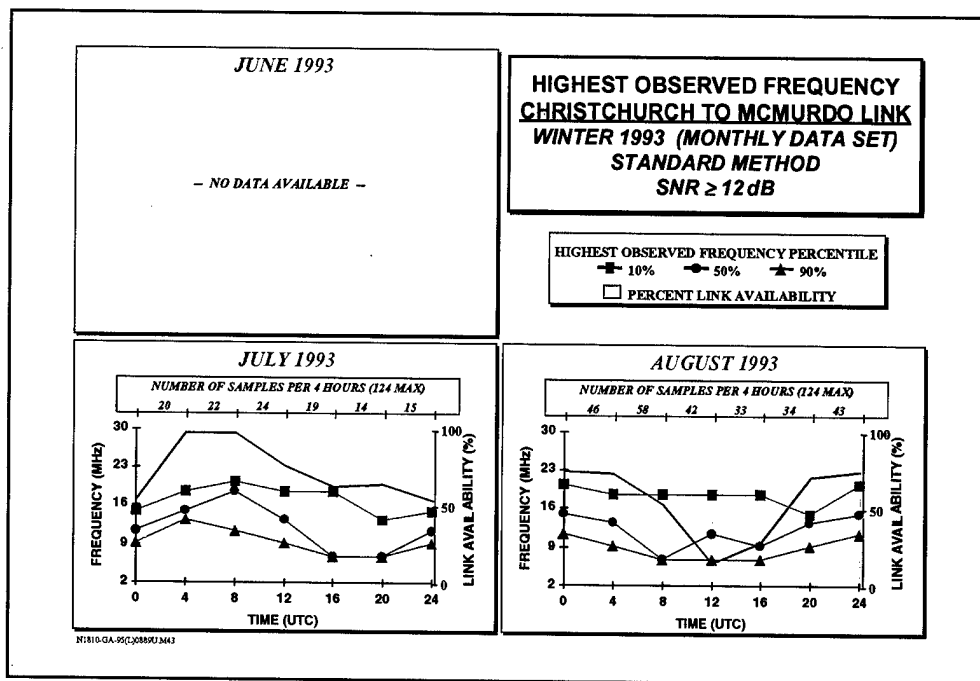


Figure 126. Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-McMurdo Link by Month, Winter 1993 (12-dB Minimum Measured SINAD)

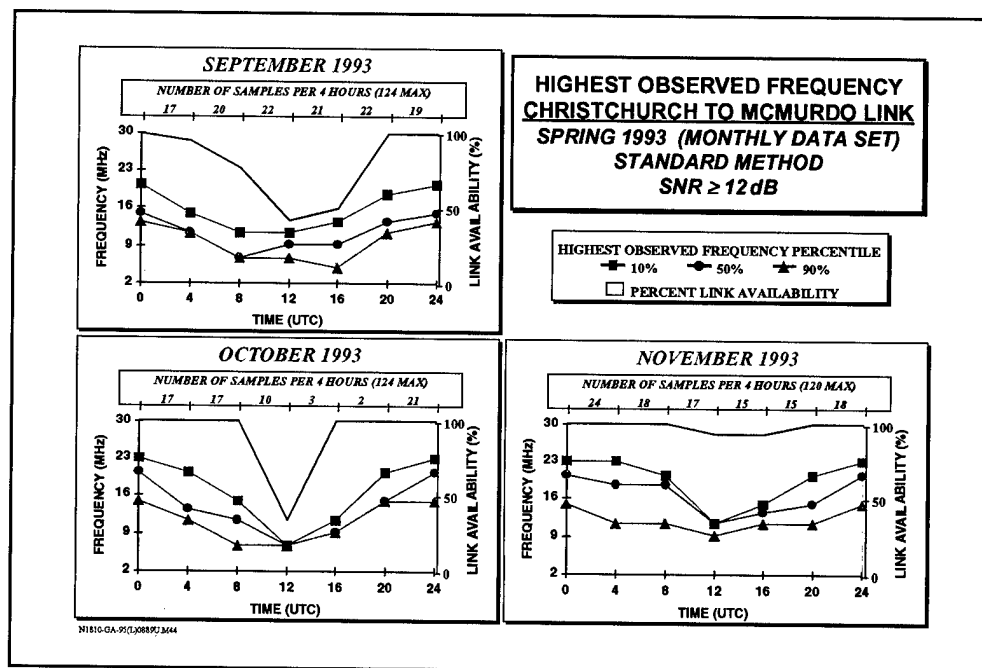


Figure 127. Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-McMurdo Link by Month, Spring 1993 (12-dB Minimum Measured SINAD)

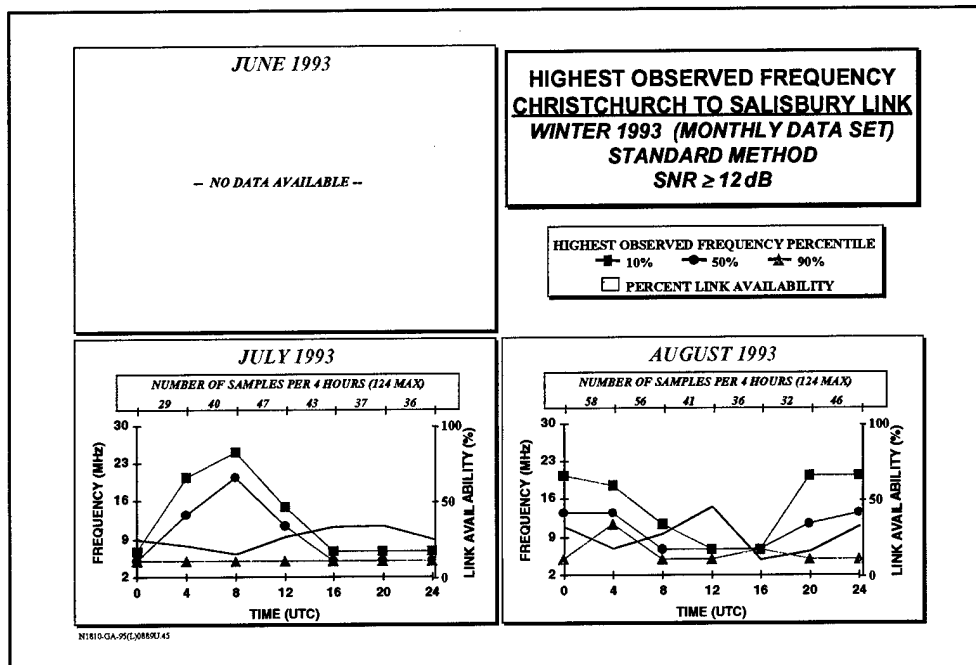


Figure 128. Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-Salisbury Link by Month, Winter 1993 (12-dB Minimum Measured SINAD)

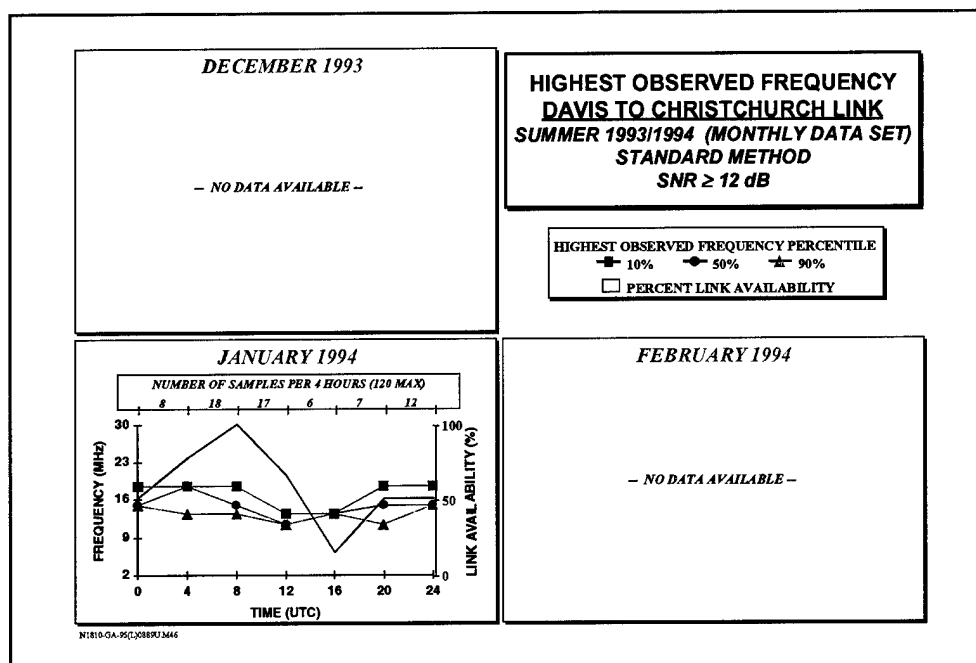


Figure 129. Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-Christchurch Link by Month, Summer 1993/1994 (12-dB Minimum Measured SINAD)

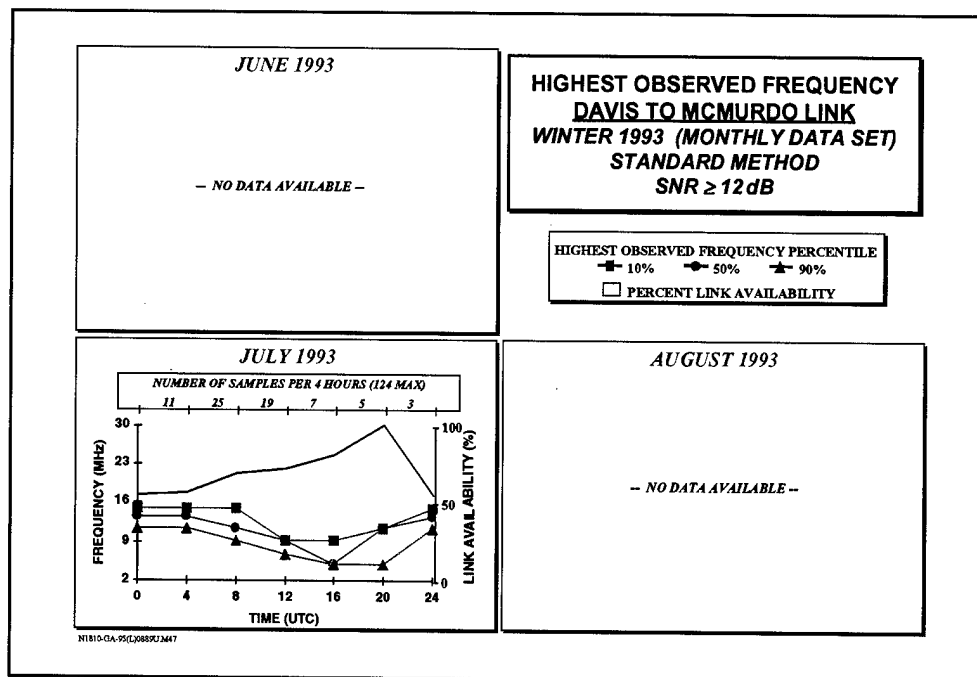


Figure 130. Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-McMurdo Link by Month, Winter 1993 (12-dB Minimum Measured SINAD)

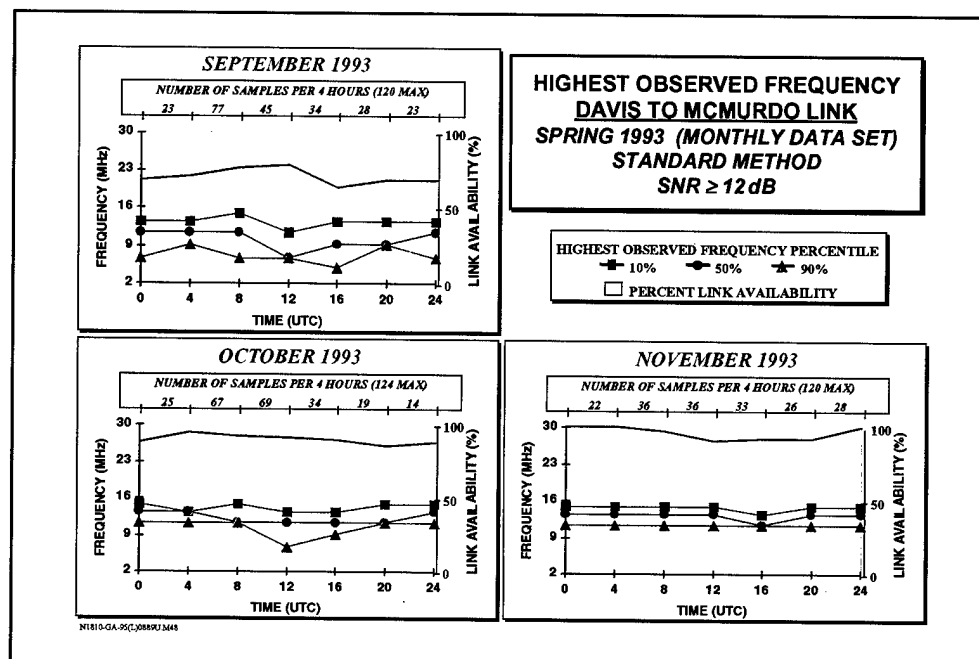


Figure 131. Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-McMurdo Link by Month, Spring 1993 (12-dB Minimum Measured SINAD)

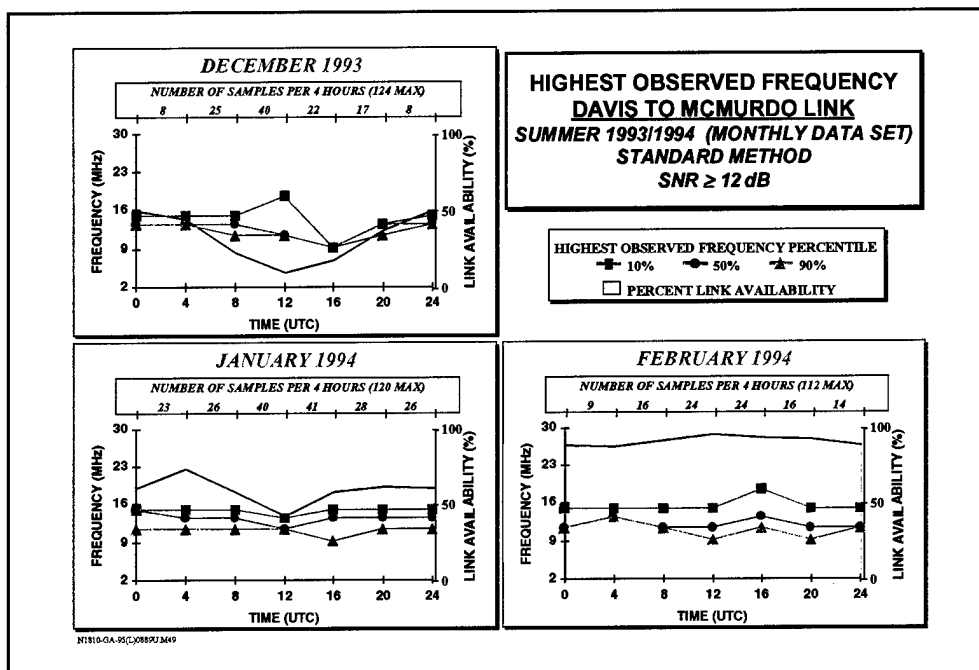


Figure 132. Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-McMurdo Link by Month, Summer 1993/1994 (12-dB Minimum Measured SINAD)

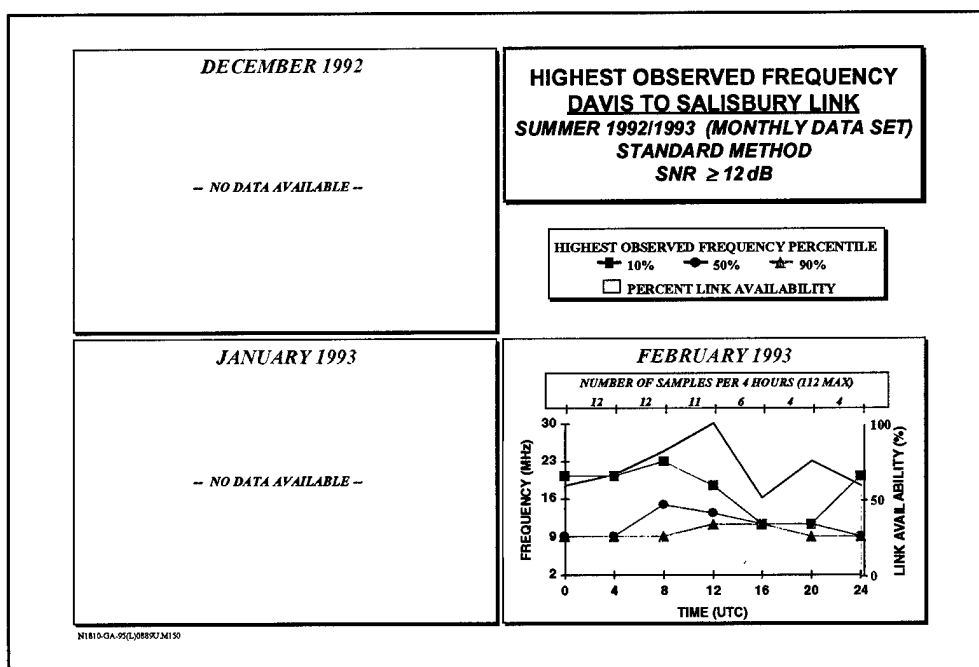


Figure 133. Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-Salisbury Link by Month, Summer 1992/1993 (12-dB Minimum Measured SINAD)

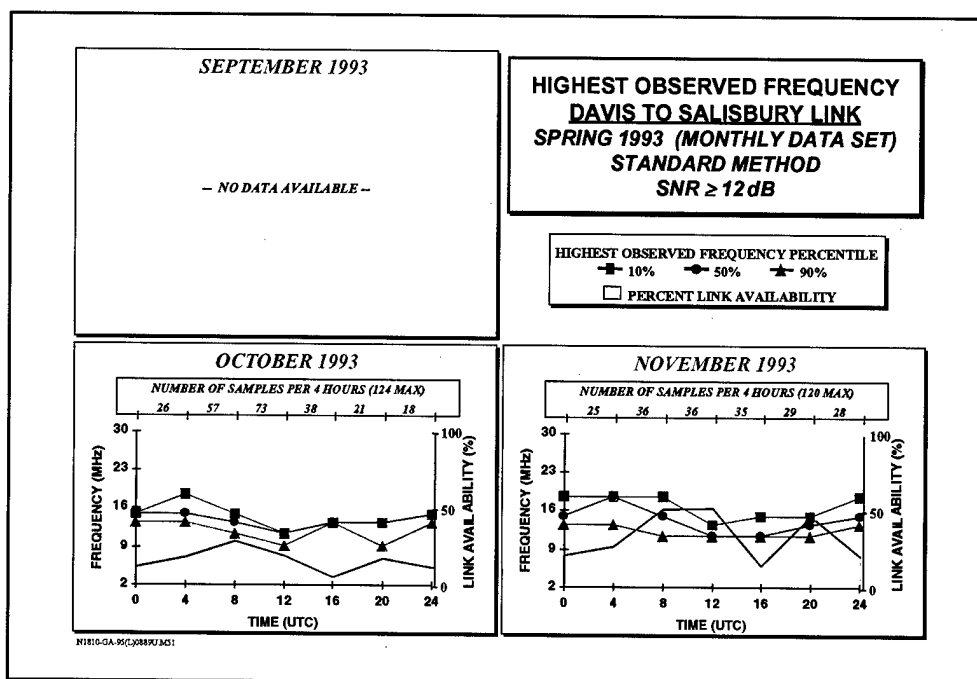


Figure 134. Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-Salisbury Link by Month, Spring 1993 (12-dB Minimum Measured SINAD)

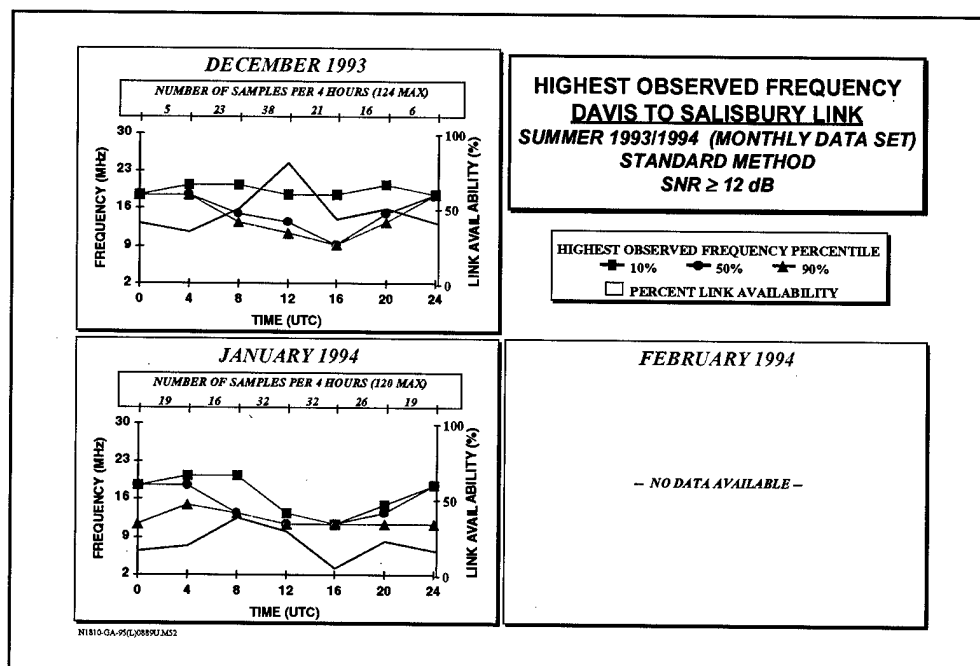
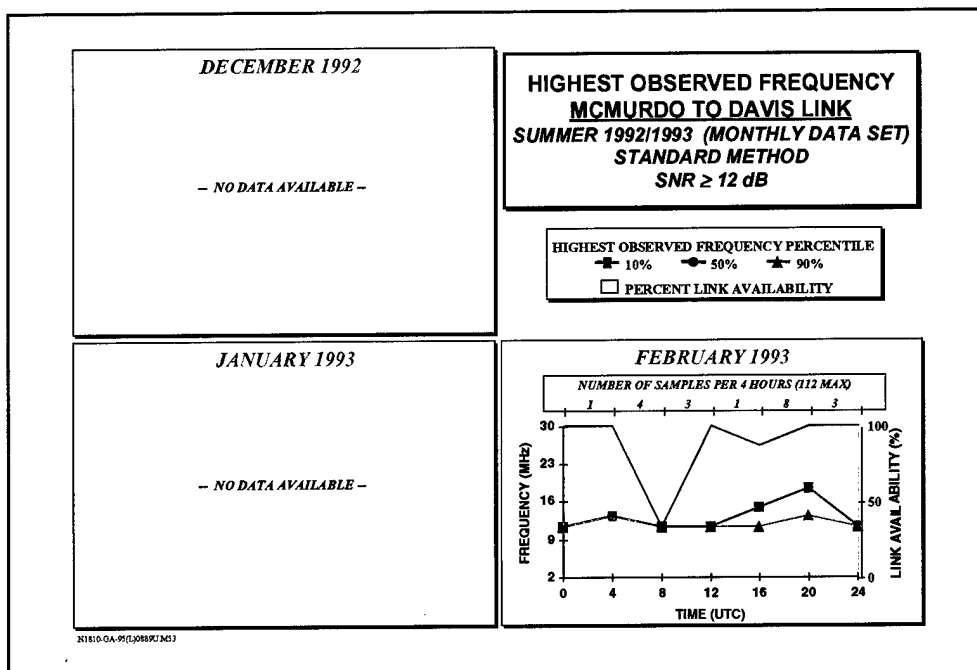
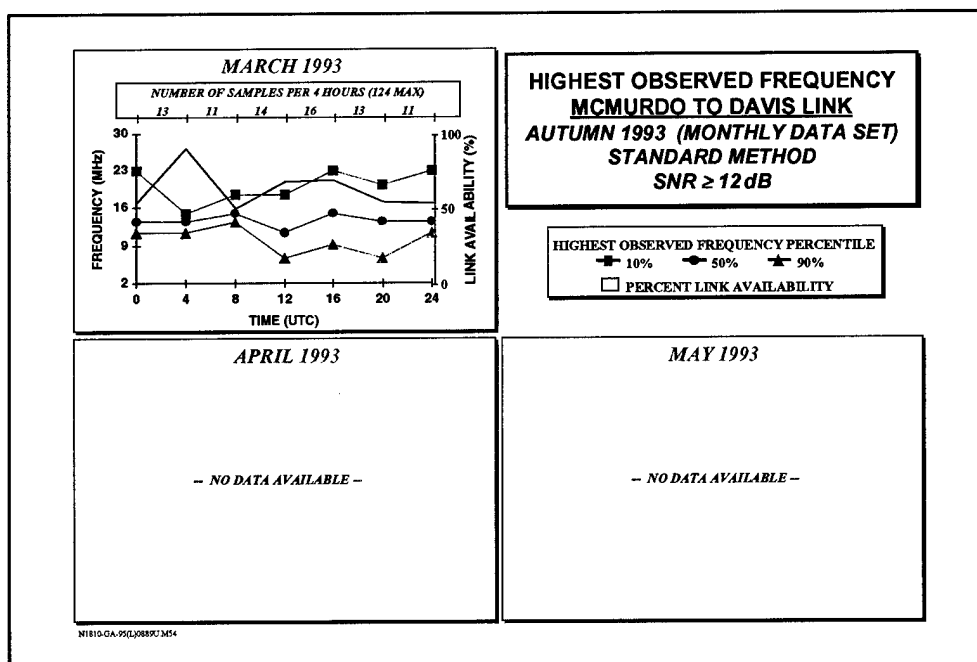


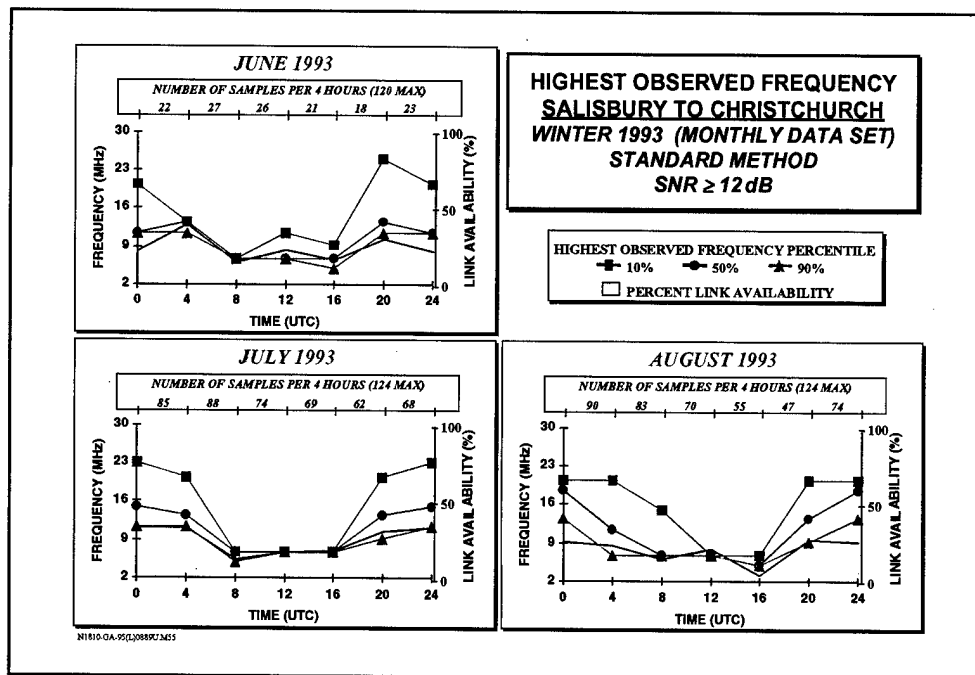
Figure 135. Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-Salisbury Link by Month, Summer 1993/1994 (12-dB Minimum Measured SINAD)



136. Exceedance (90%, 50%, and 10%) for Best Frequency, McMurdo-to-Davis Link by Month, Summer 1992/1993 (12-dB Minimum Measured SINAD)



137. Exceedance (90%, 50%, and 10%) for Best Frequency, McMurdo-to-Davis Link by Month, Fall 1993 (12-dB Minimum Measured SINAD)



138. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Christchurch Link by Month, Winter 1993 (12-dB Minimum Measured SINAD)

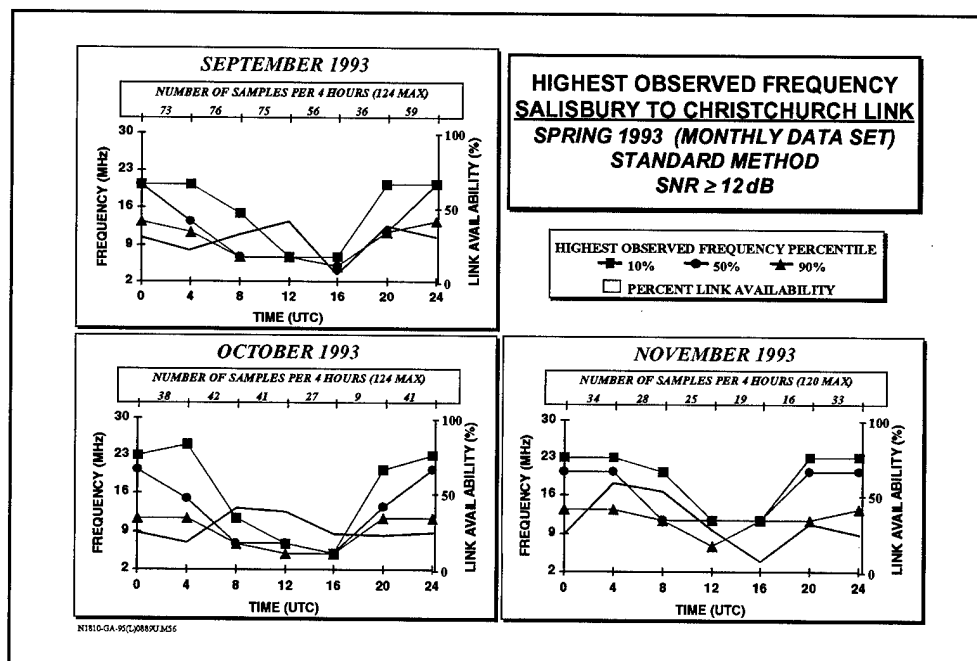


Figure 139. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Christchurch Link by Month, Spring 1993 (12-dB Minimum Measured SINAD)

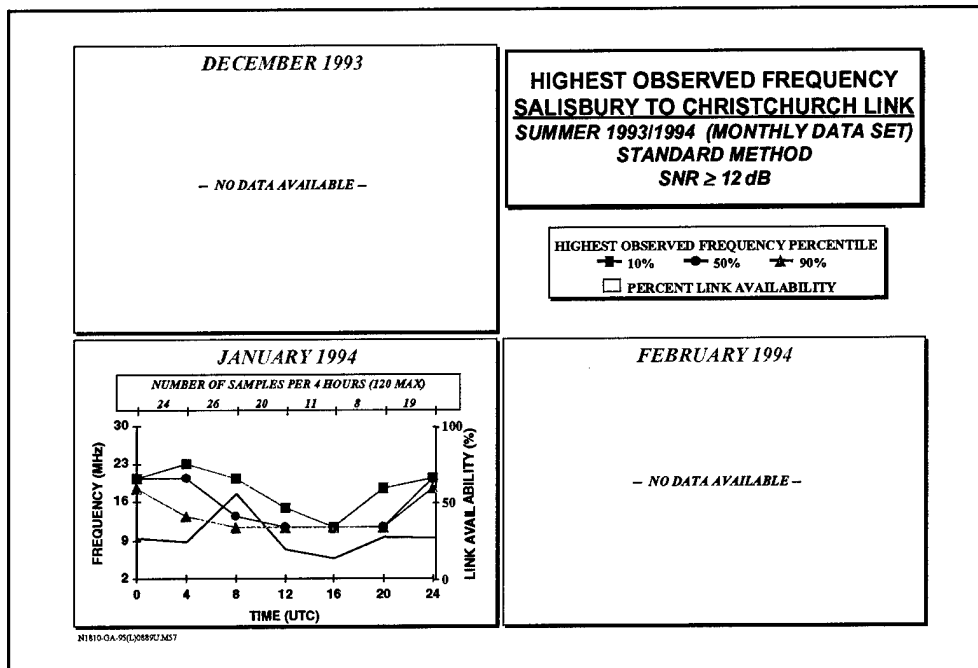


Figure 140. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Christchurch Link by Month, Summer 1993/1994 (12-dB Minimum Measured SINAD)

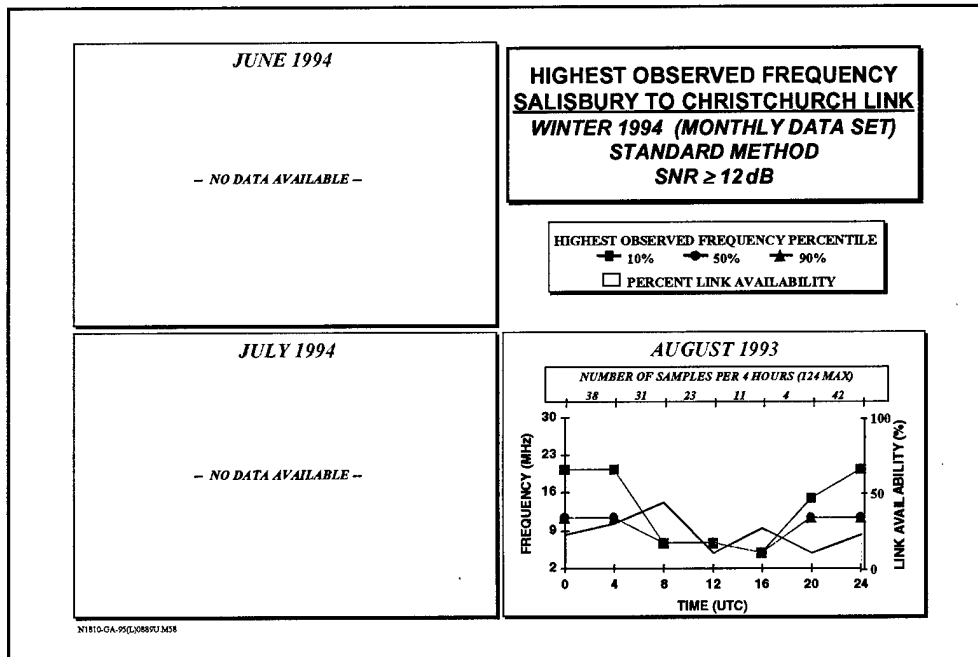


Figure 141. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Christchurch Link by Month, Winter 1994 (12-dB Minimum Measured SINAD)

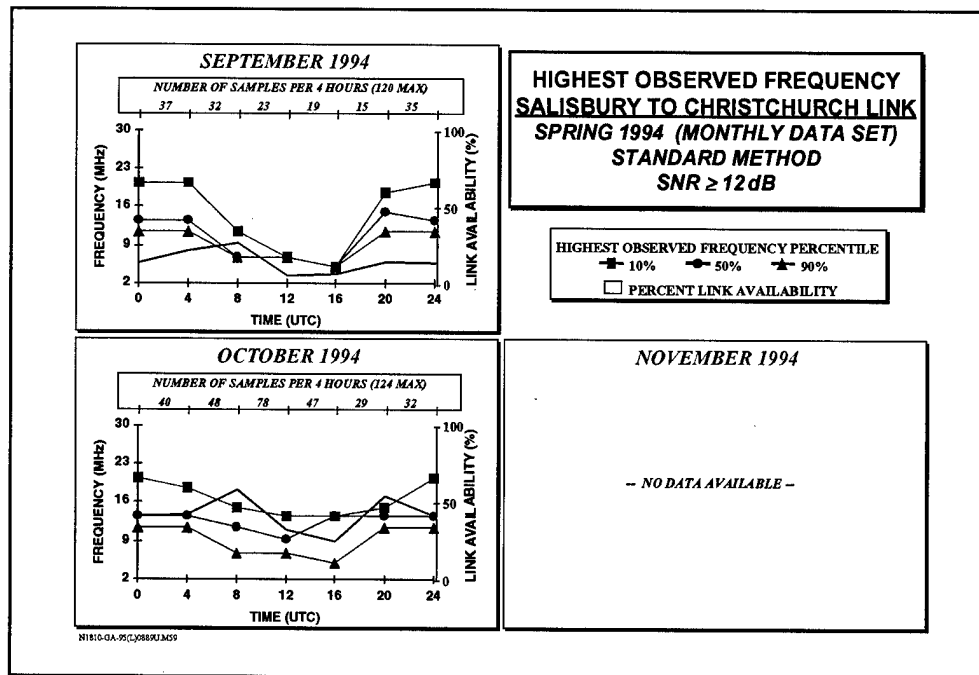


Figure 142. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Christchurch Link by Month, Spring 1994 (12-dB Minimum Measured SINAD)

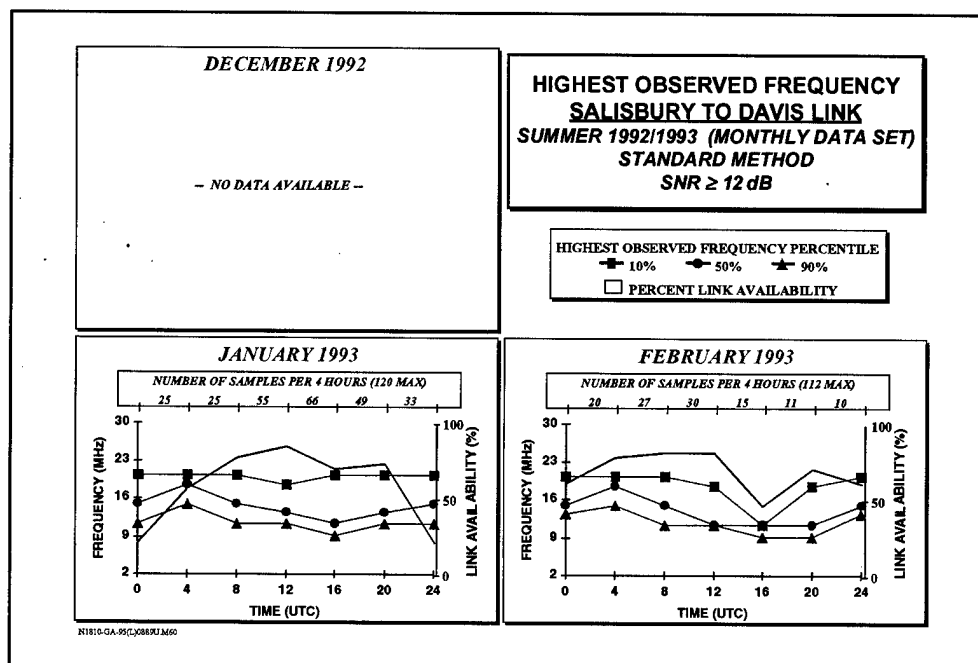


Figure 143. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Davis Link by Month, Summer 1992/1993 (12-dB Minimum Measured SINAD)

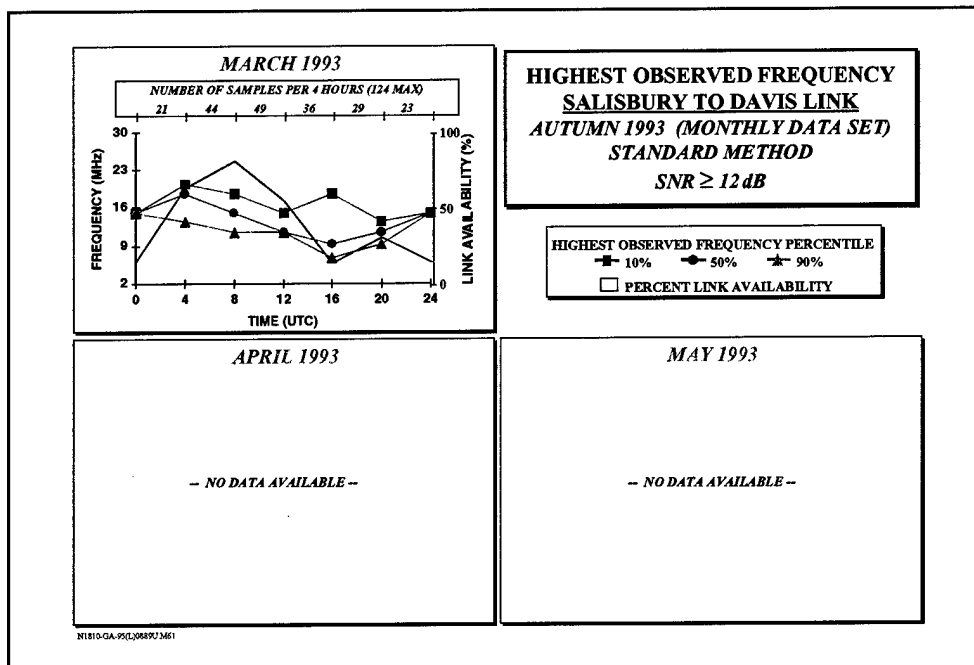


Figure 144. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Davis Link by Month, Fall 1993 (12-dB Minimum Measured SINAD)

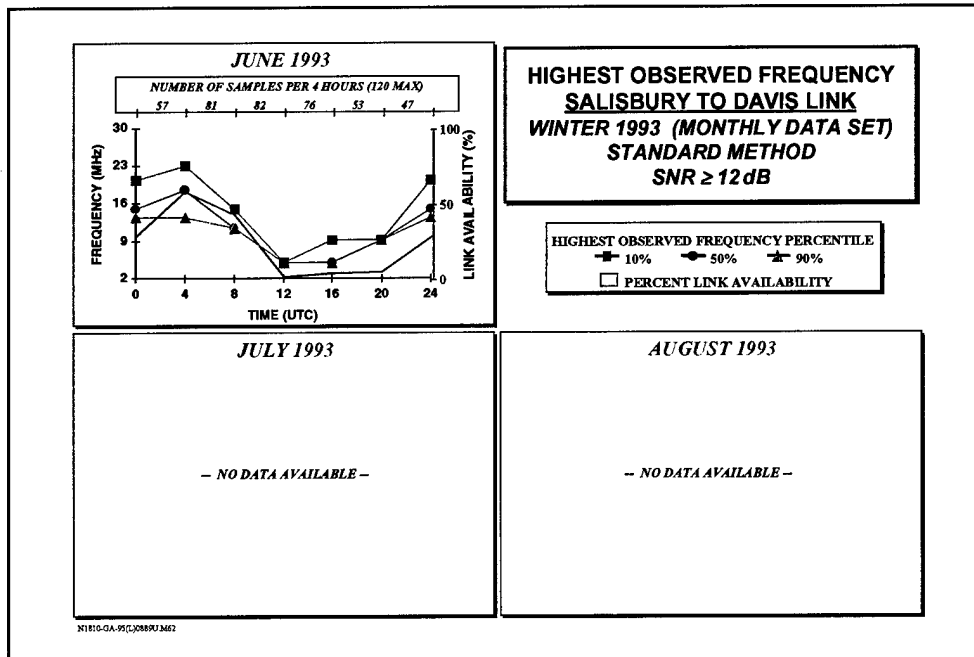


Figure 145. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Davis Link by Month, Winter 1993 (12-dB Minimum Measured SINAD)

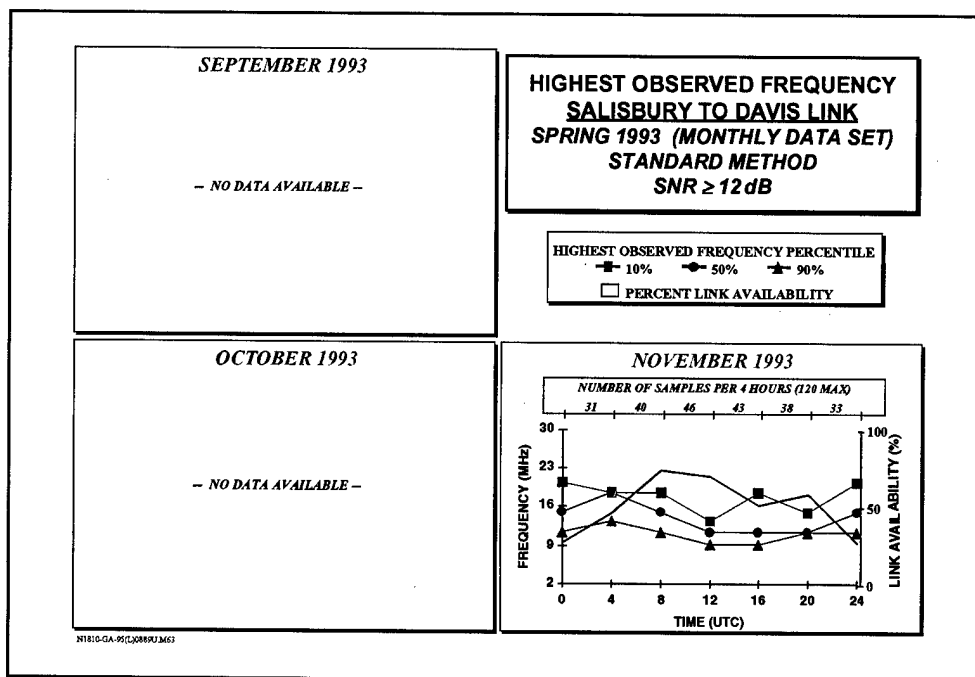


Figure 146. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Davis Link by Month, Spring 1993 (6-dB Minimum Measured SINAD)

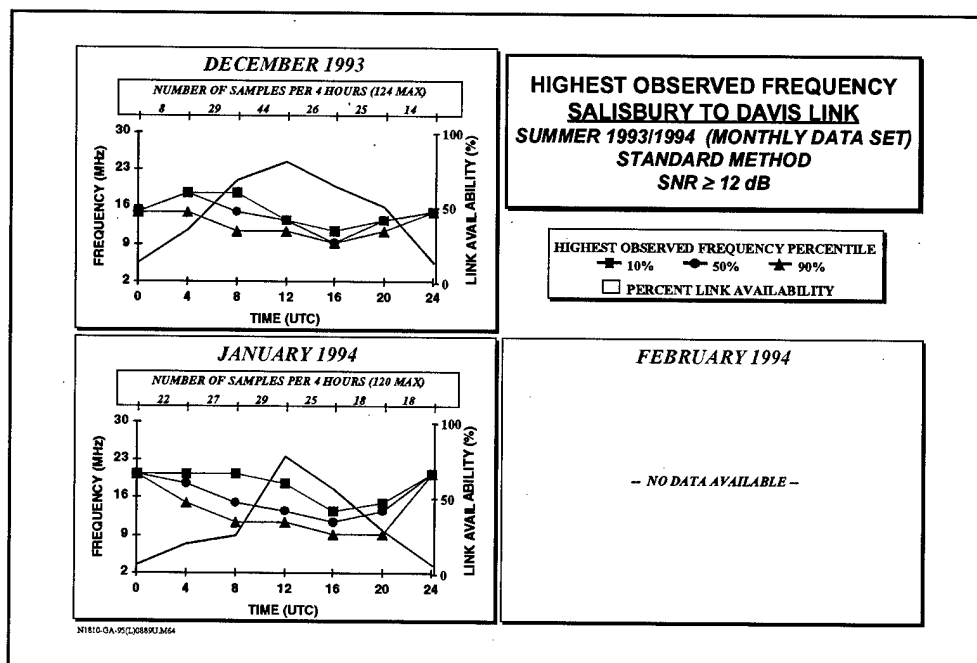


Figure 147. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Davis Link by Month, Summer 1993/1994 (12-dB Minimum Measured SINAD)

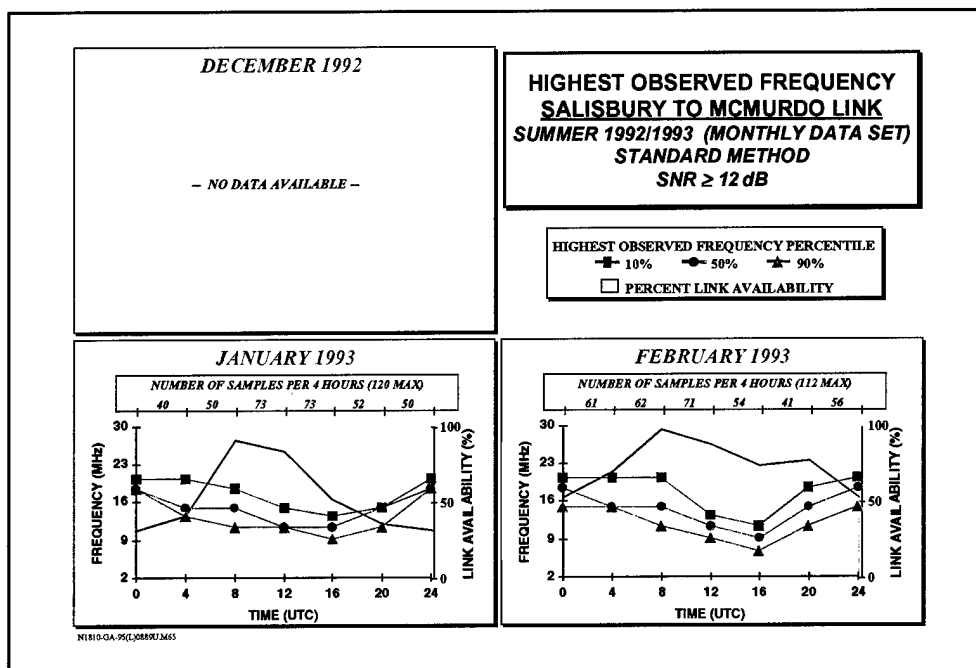


Figure 148. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Month, Summer 1992/1993 (12-dB Minimum Measured SINAD)

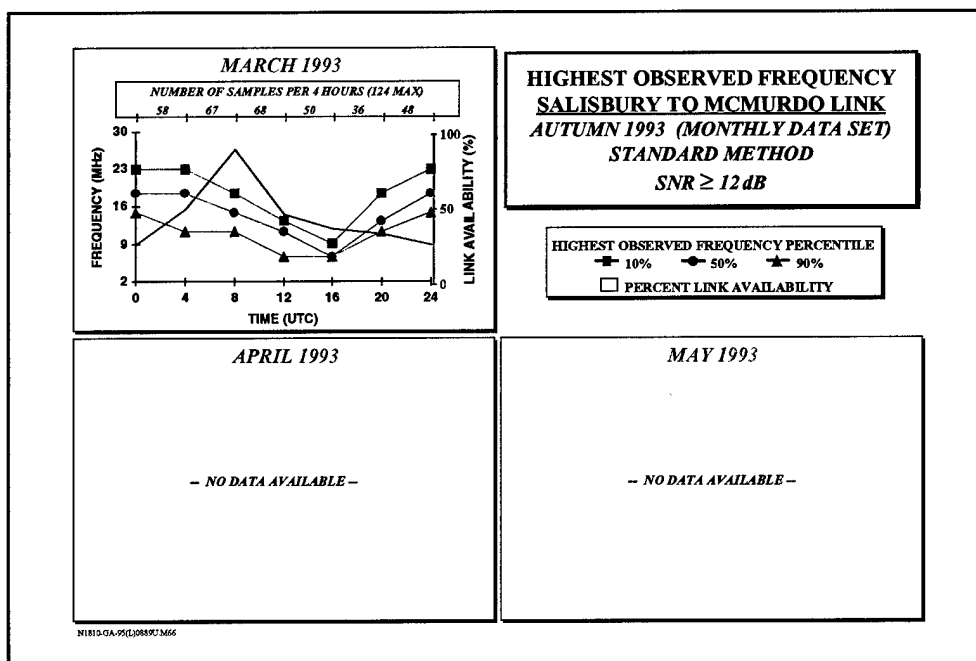


Figure 149. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Month, Fall 1993 (12-dB Minimum Measured SINAD)

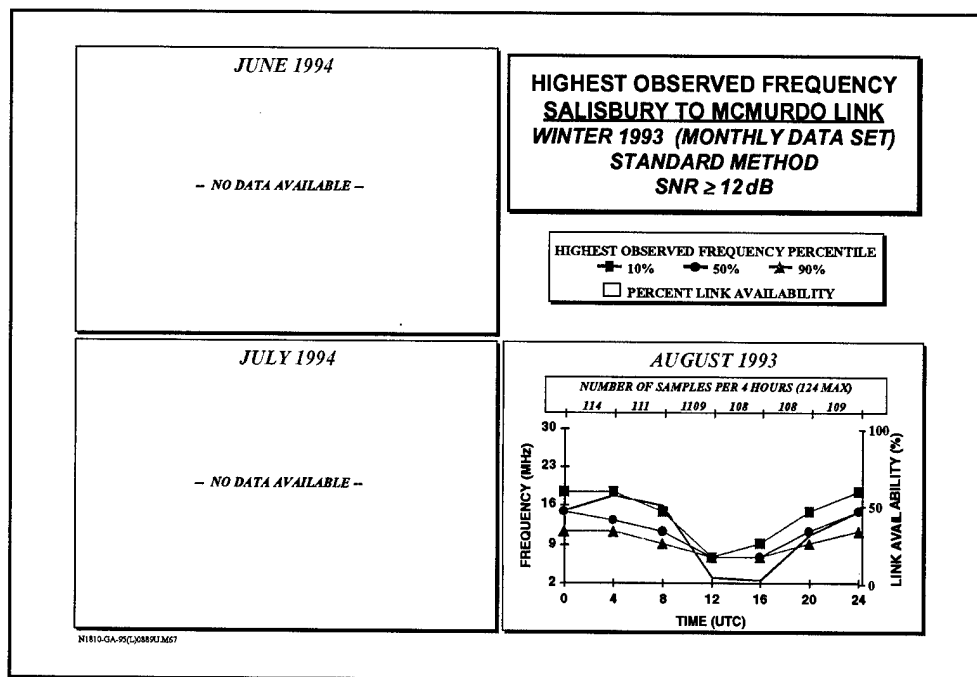


Figure 150. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Month, Winter 1993 (12-dB Minimum Measured SINAD)

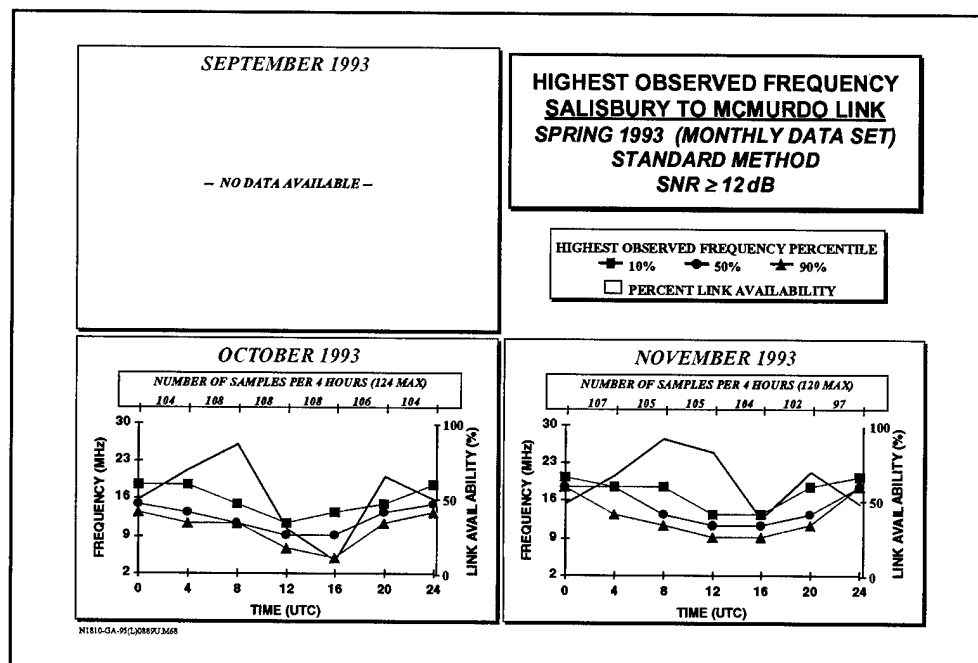


Figure 151. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Month, Spring 1993 (12-dB Minimum Measured SINAD)

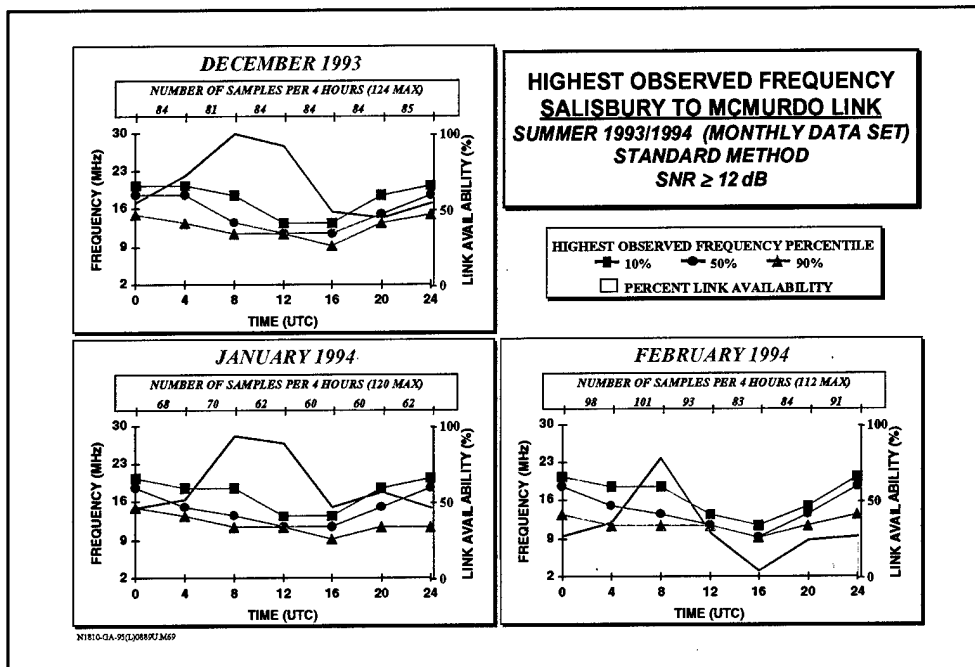


Figure 152. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Month, Summer 1993/1994 (12-dB Minimum Measured SINAD)

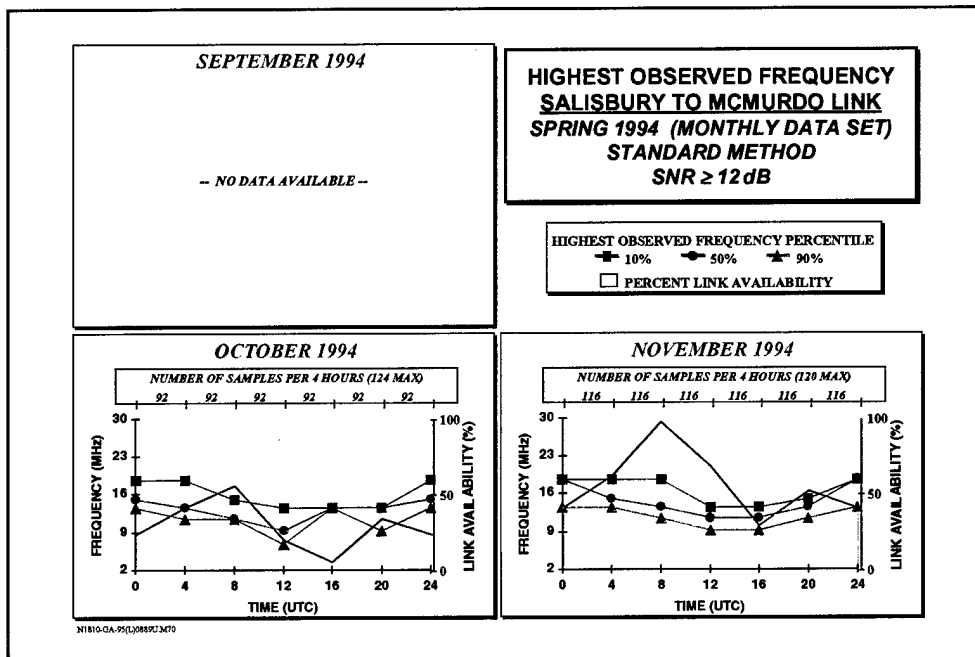


Figure. 153. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Month, Spring 1994 (12-dB Minimum Measured SINAD)

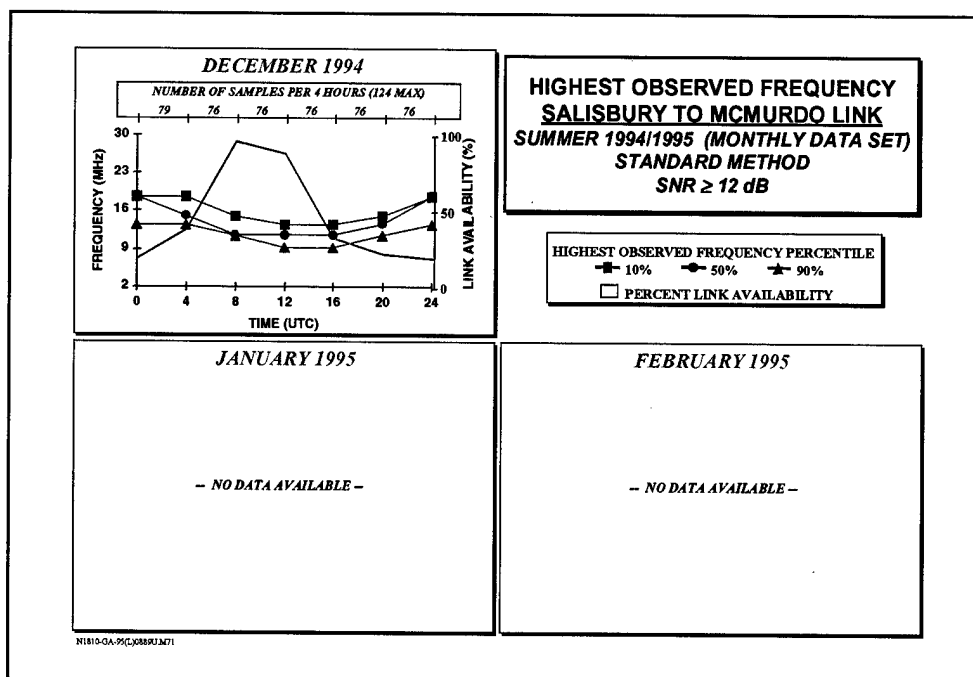


Figure 154. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Month, Summer 1994/1995 (12-dB Minimum Measured SINAD)

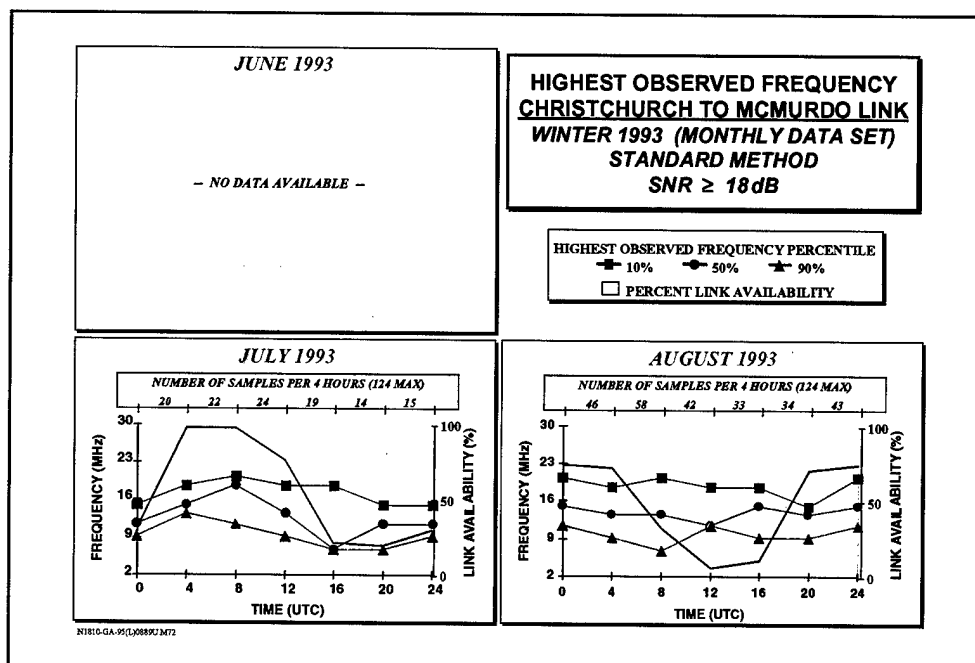


Figure 155. Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-McMurdo Link by Month, Winter 1993 (18-dB Minimum Measured SINAD)

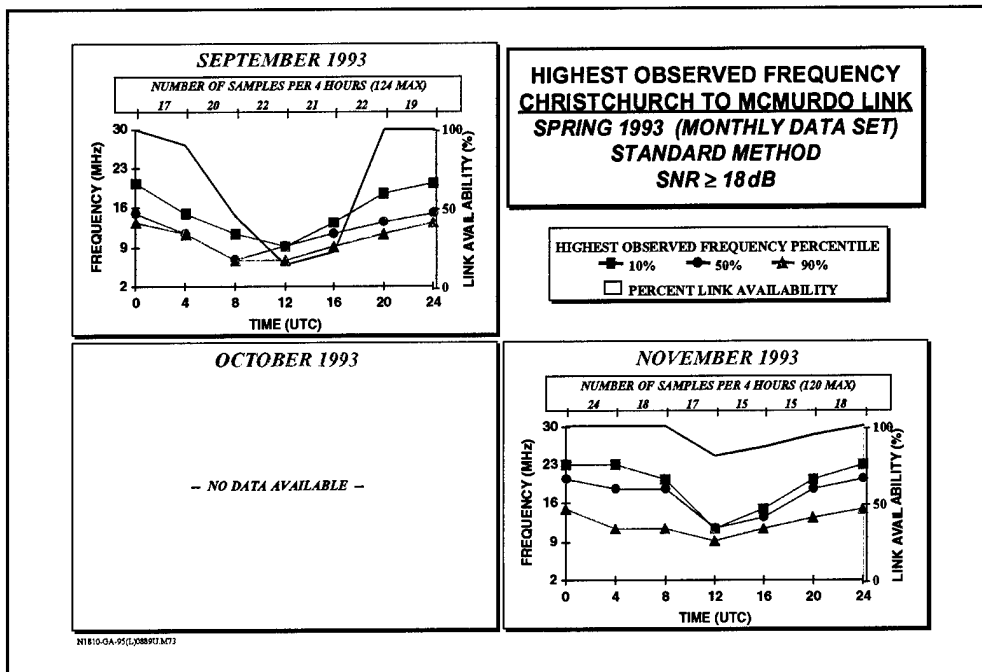


Figure 156. Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-McMurdo Link by Month, Spring 1993 (18-dB Minimum Measured SINAD)

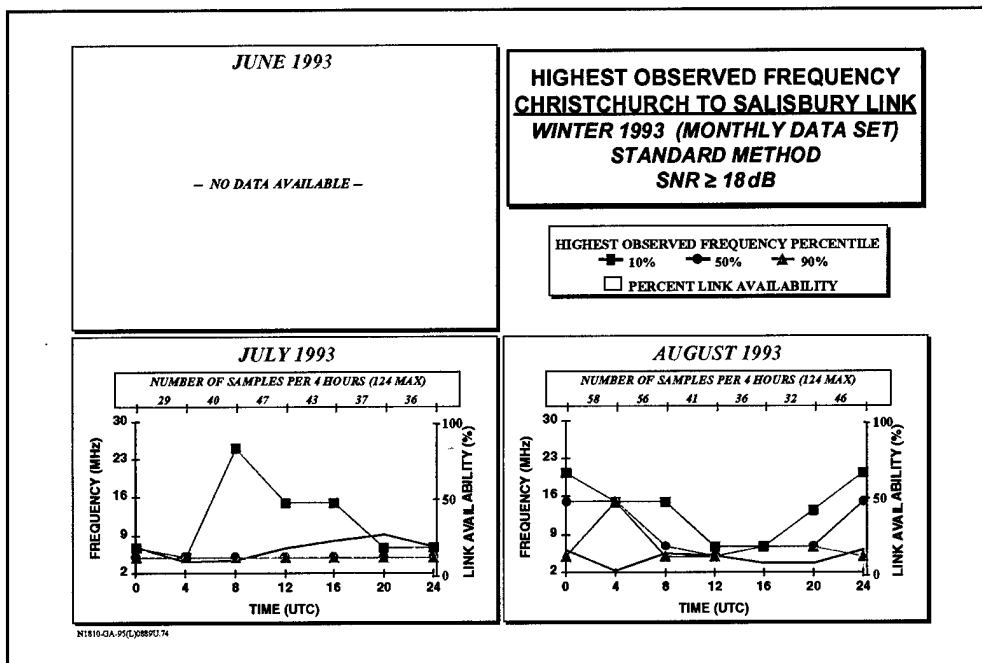


Figure 157. Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-Salisbury Link by Month, Winter 1993 (18-dB Minimum Measured SINAD)

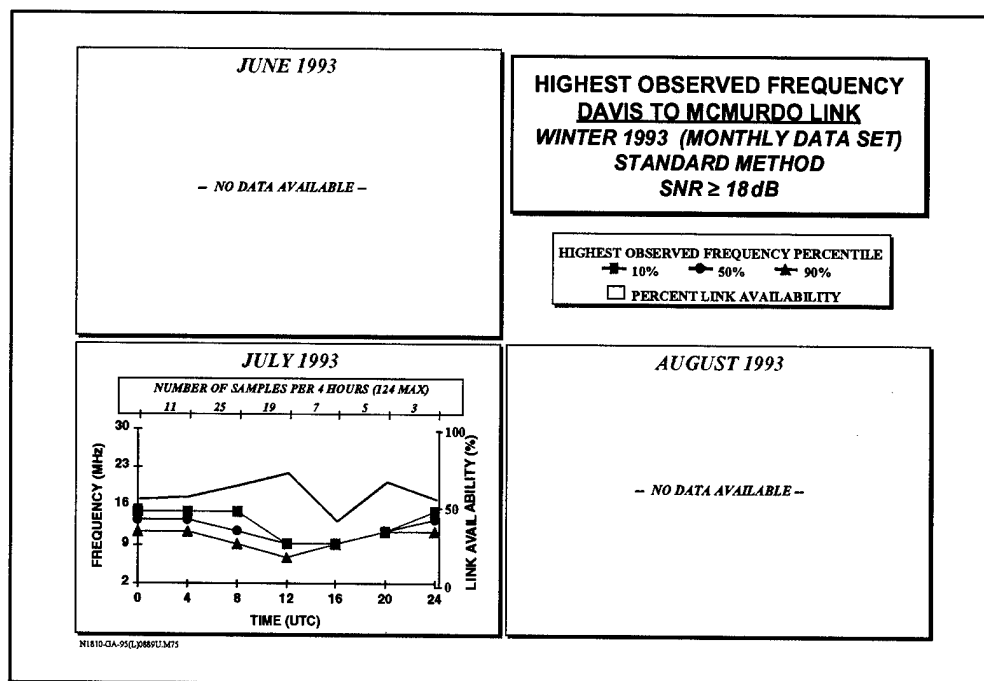


Figure 158. Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-McMurdo Link by Month, Winter 1993 (18-dB Minimum Measured SINAD)

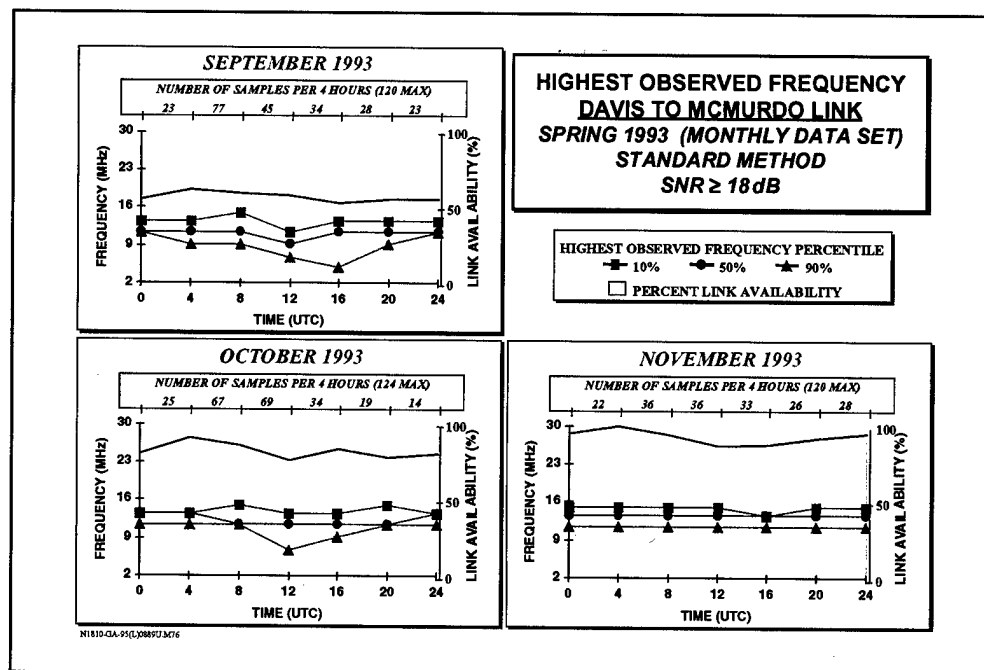


Figure 159. Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-McMurdo Link by Month, Spring 1993 (18-dB Minimum Measured SINAD)

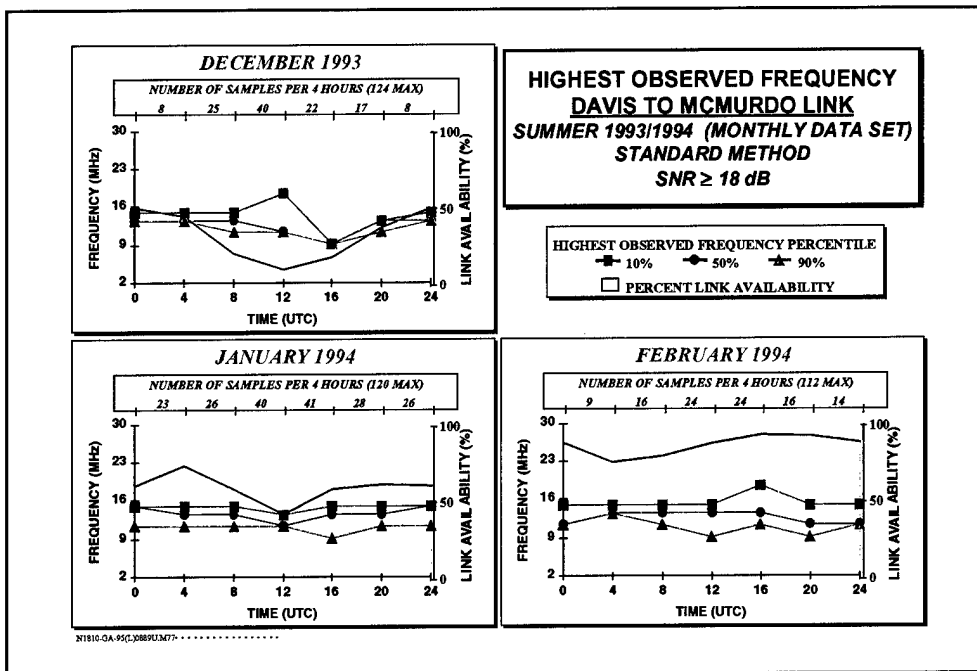


Figure 160. Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-McMurdo Link by Month, Summer 1993/1994 (18-dB Minimum Measured SINAD)

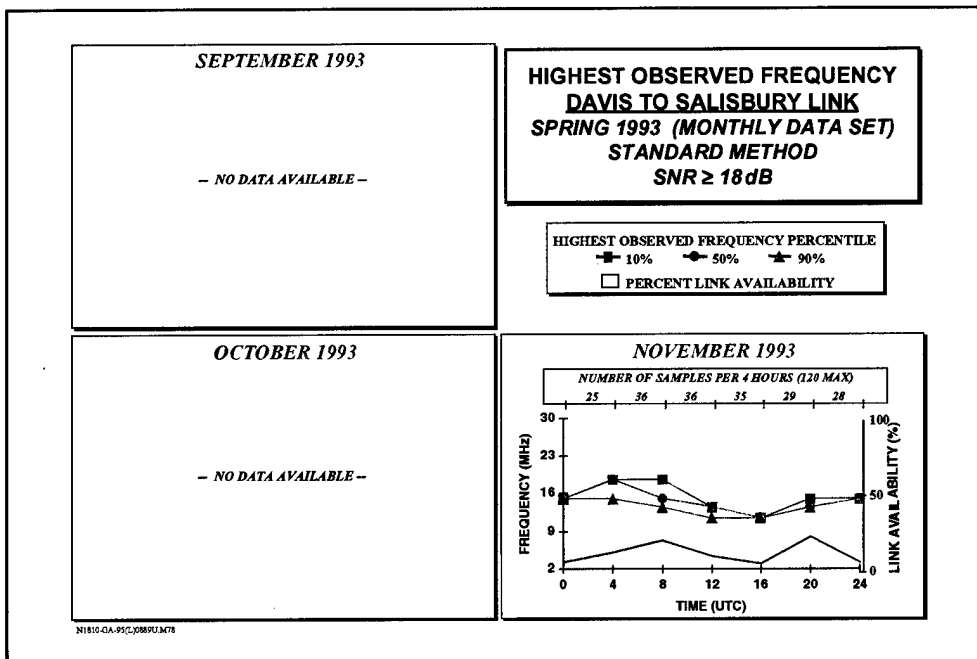


Figure 161. Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-Salisbury Link by Month, Spring 1993 (18-dB Minimum Measured SINAD)

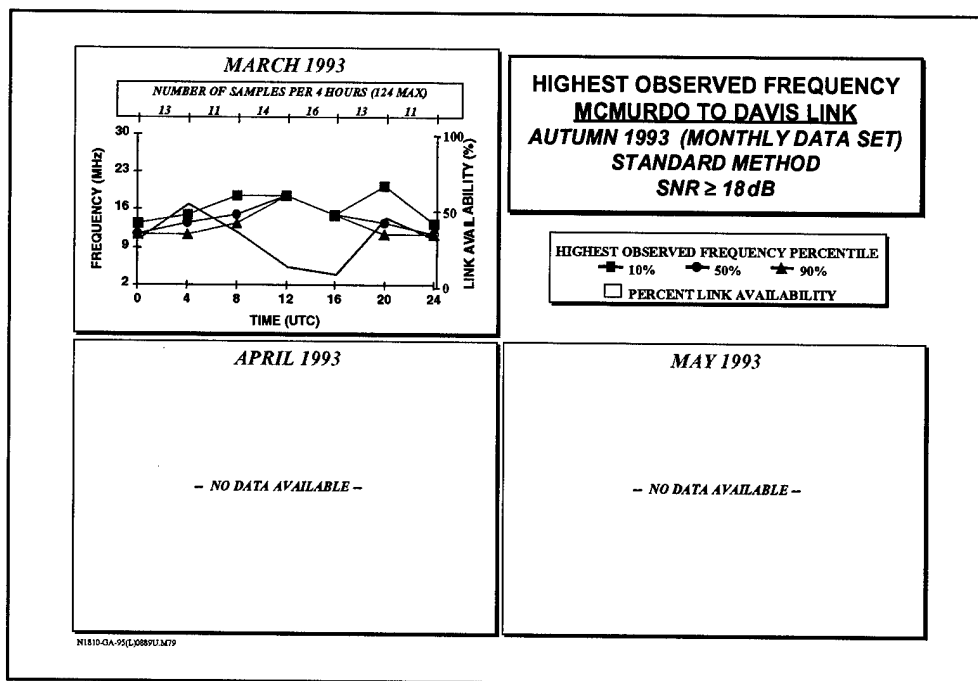


Figure 162. Exceedance (90%, 50%, and 10%) for Best Frequency, McMurdo-to-Davis Link by Month, Fall 1993 (18-dB Minimum Measured SINAD)

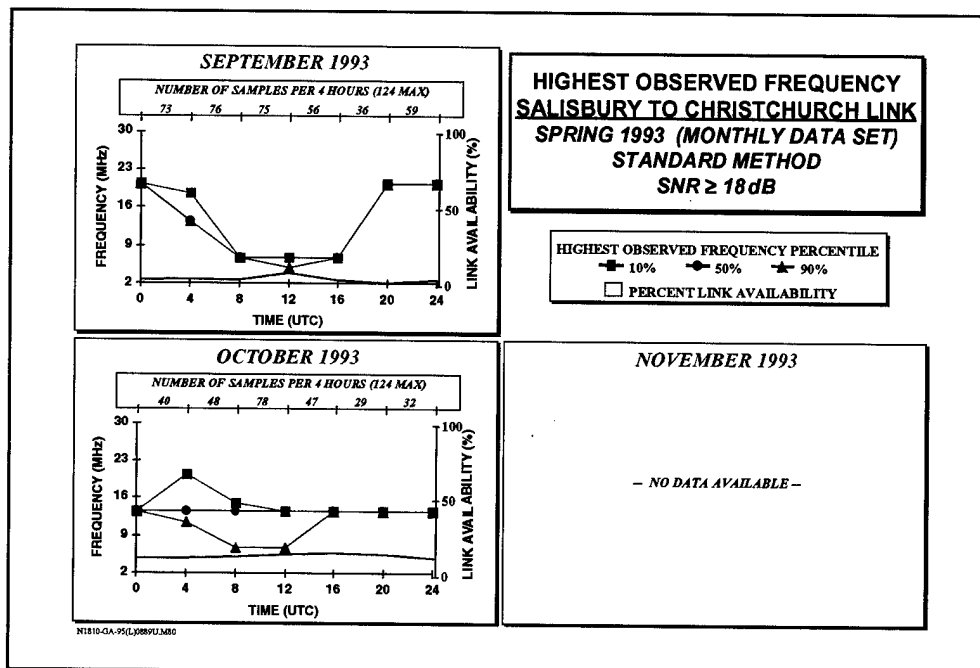


Figure 163. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Christchurch Link by Month, Spring 1993 (18-dB Minimum Measured SINAD)

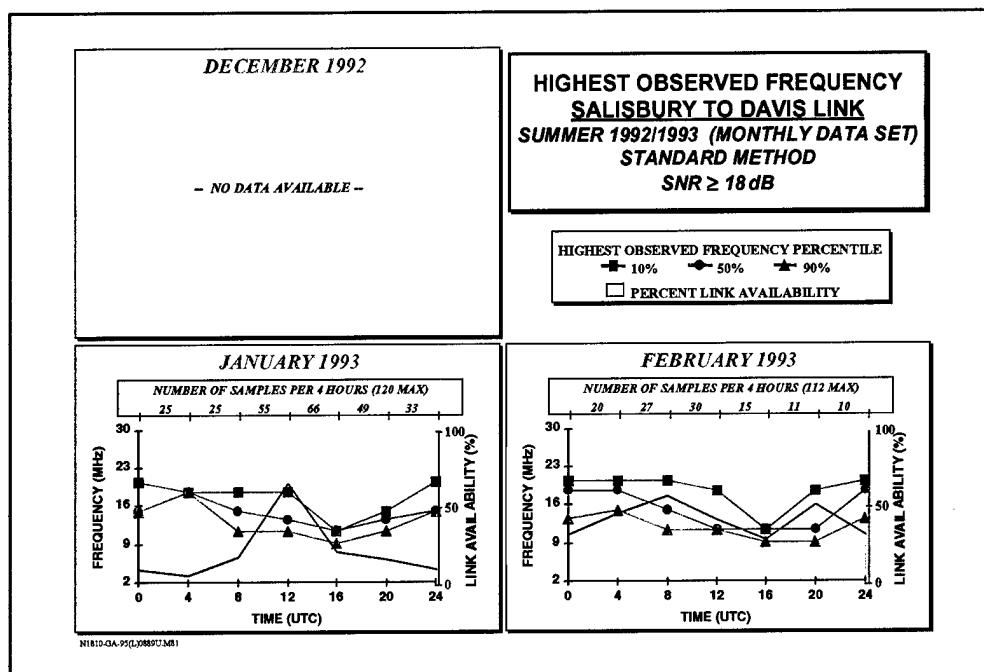


Figure 164. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Davis Link by Month, Summer 1992/1993 (18-dB Minimum Measured SINAD)

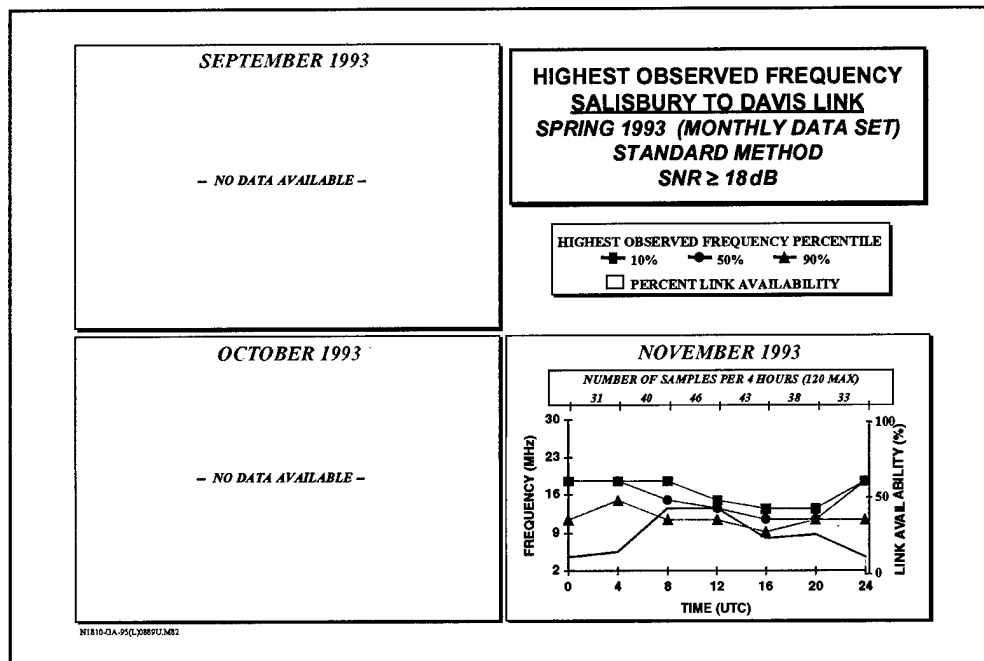


Figure 165. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Davis Link by Month, Spring 1993 (18-dB Minimum Measured SINAD)

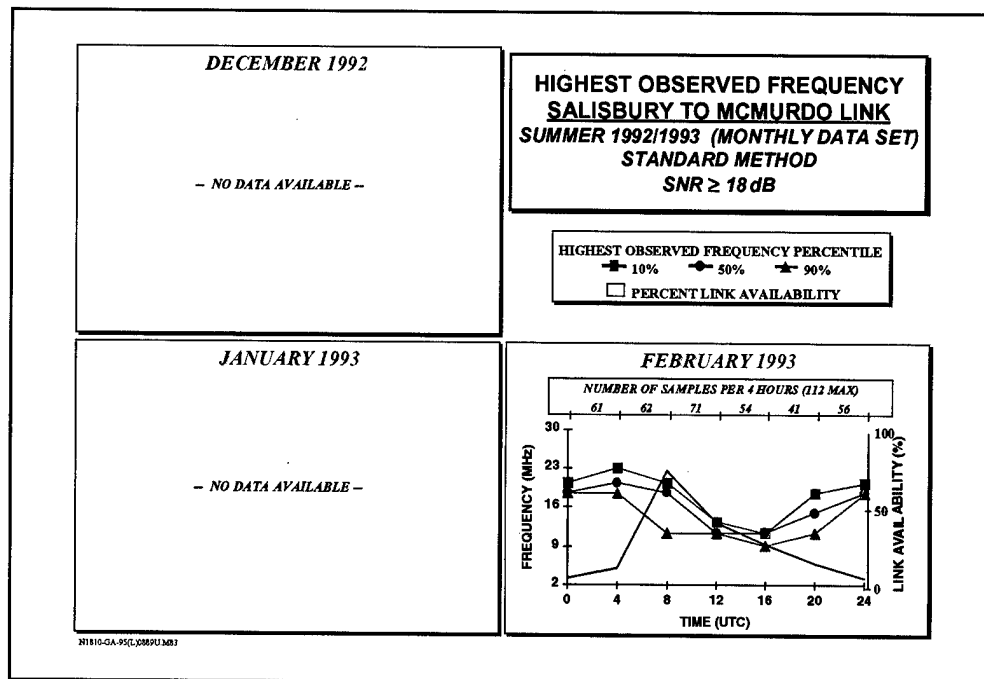


Figure 166. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Month, Summer 1992/1993 (18-dB Minimum Measured SINAD)

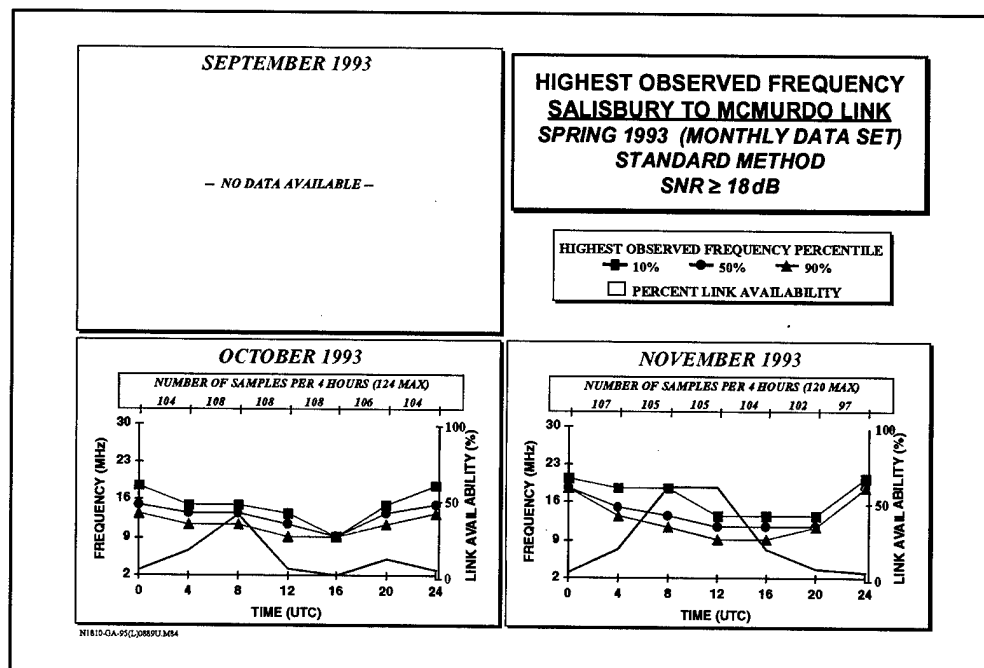


Figure 167. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Month, Spring 1993 (18-dB Minimum Measured SINAD)

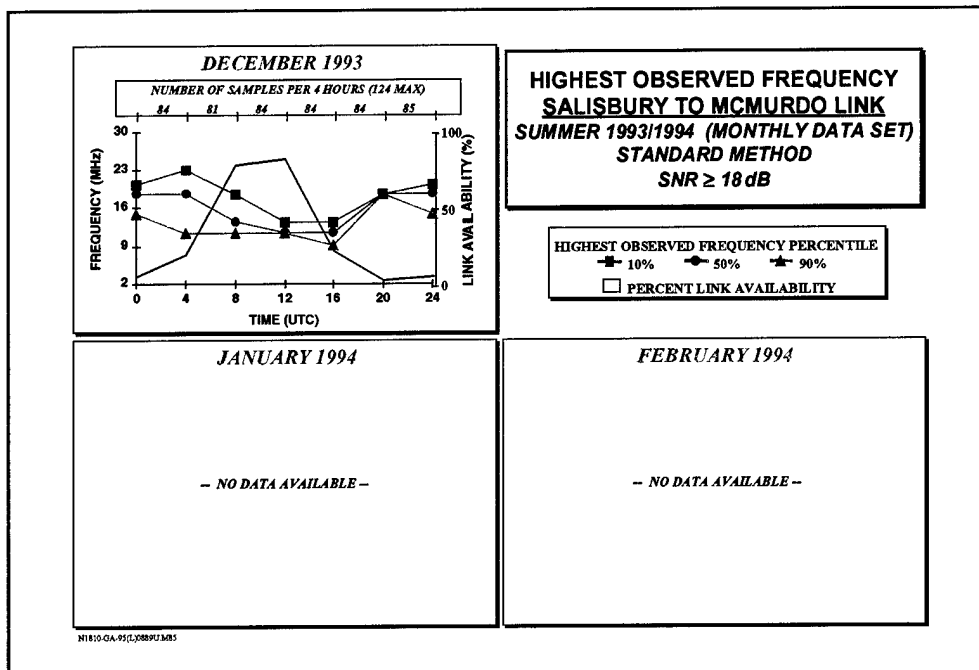


Figure 168. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Month, Summer 1993/1994 (18-dB Minimum Measured SINAD)

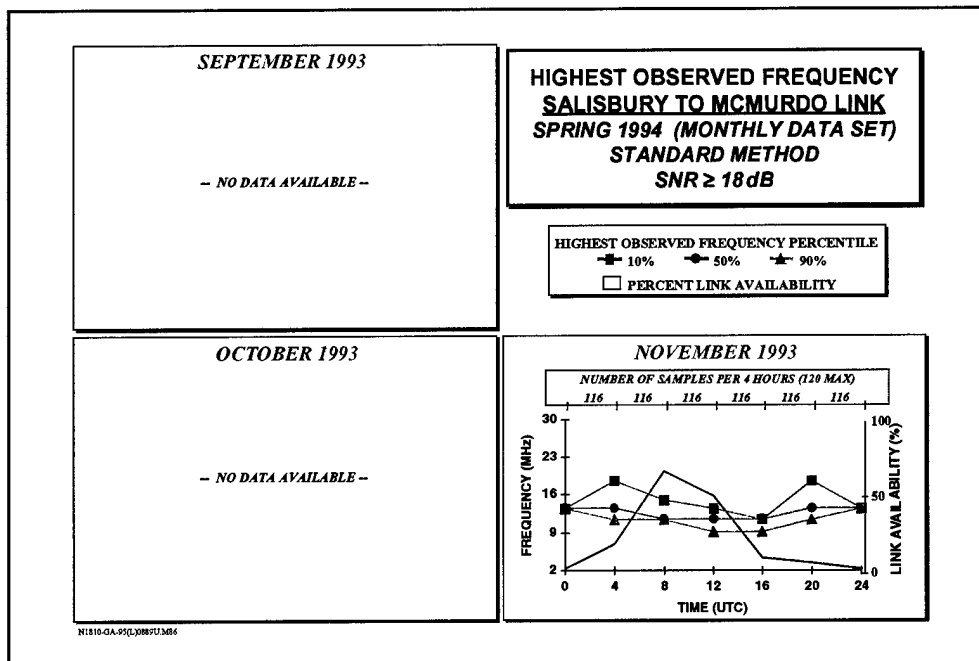


Figure 169. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Month, Spring 1994 (18-dB Minimum Measured SINAD)

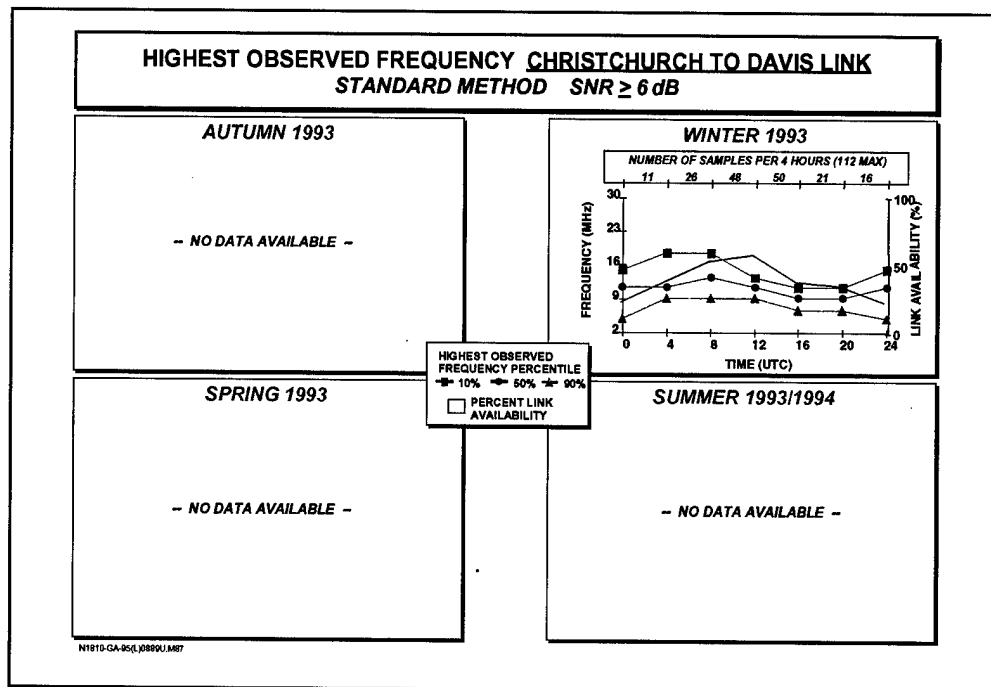


Figure 170. Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-Davis Link by Season, 1993 (6-dB Minimum Measured SINAD)

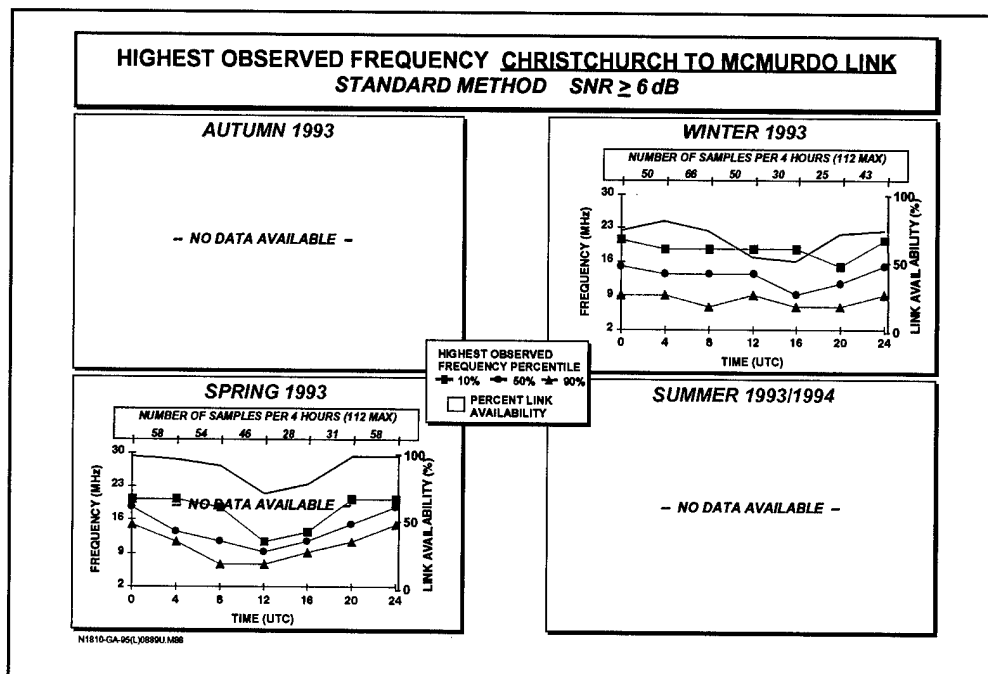


Figure 171. Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-McMurdo Link by Season, 1993 (6-dB Minimum Measured SINAD)

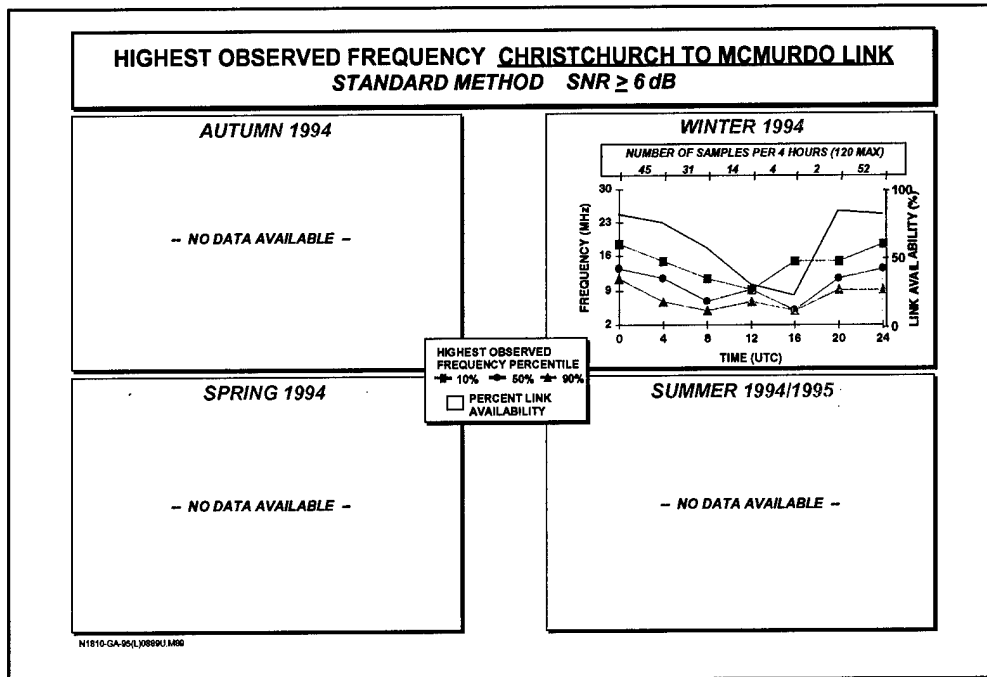


Figure 172. Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-McMurdo Link by Season, 1994 (6-dB Minimum Measured SINAD)

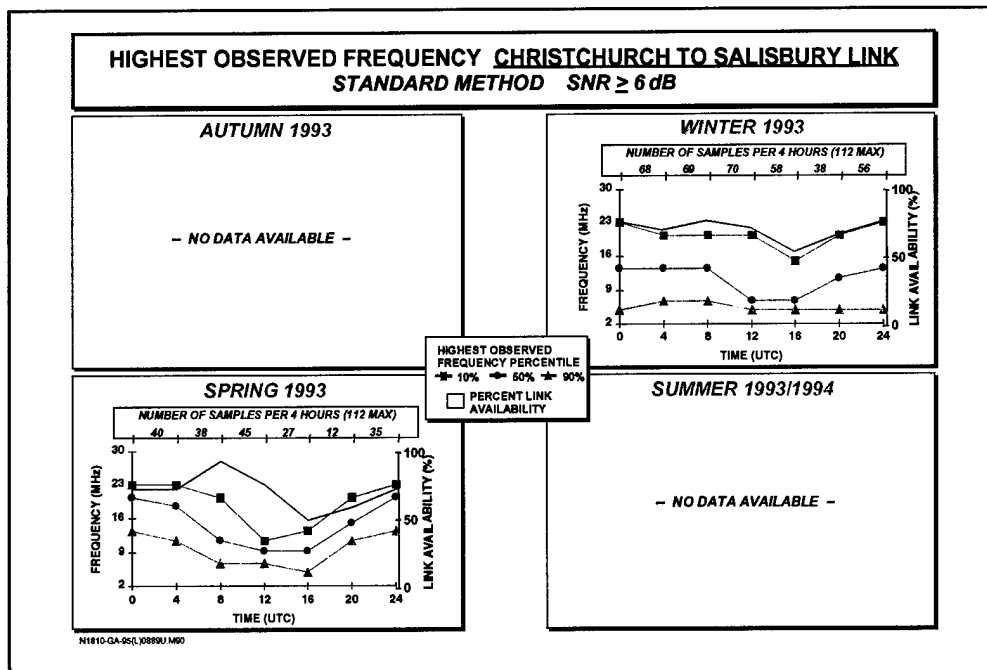


Figure 173. Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-Salisbury Link by Season, 1993 (6-dB Minimum Measured SINAD)

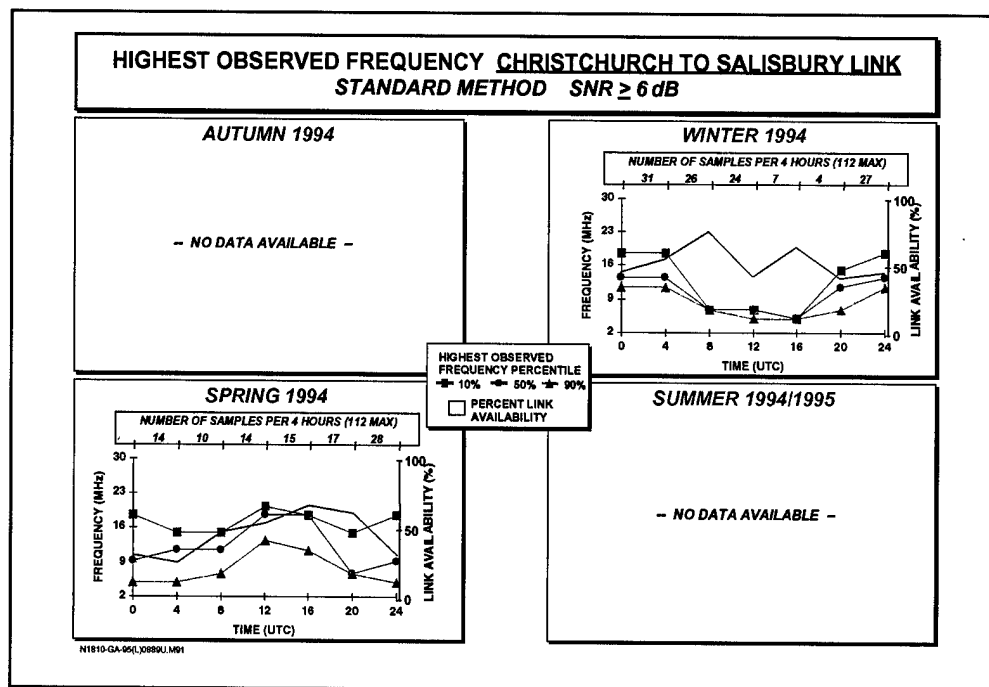


Figure 174. Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-Salisbury Link by Season, 1994 (6-dB Minimum Measured SINAD)

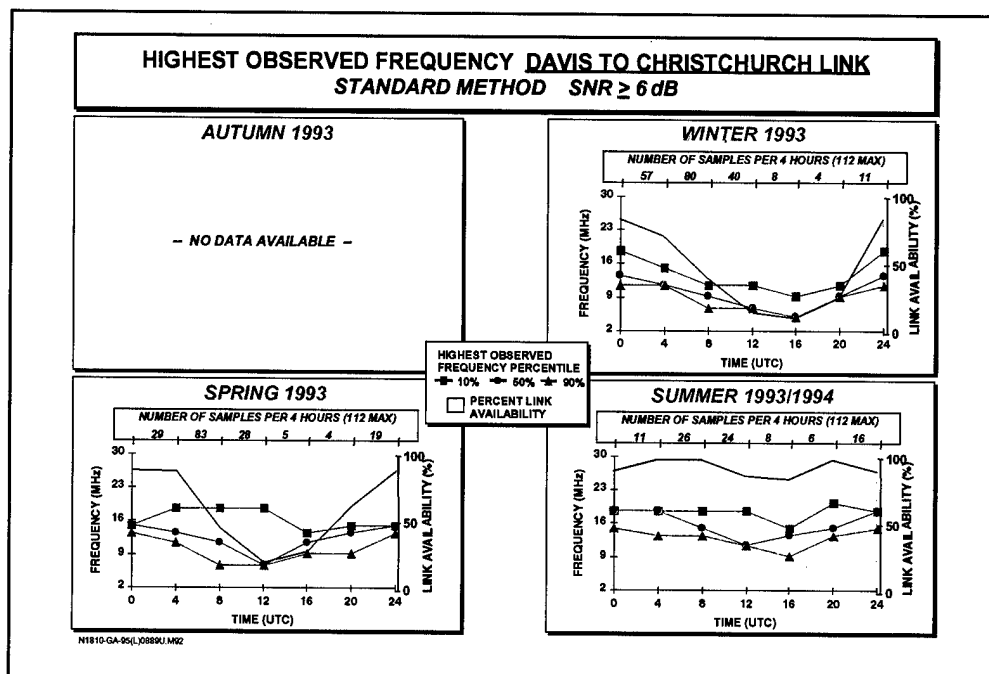


Figure 175. Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-Christchurch Link by Season, 1993 (6-dB Minimum Measured SINAD)

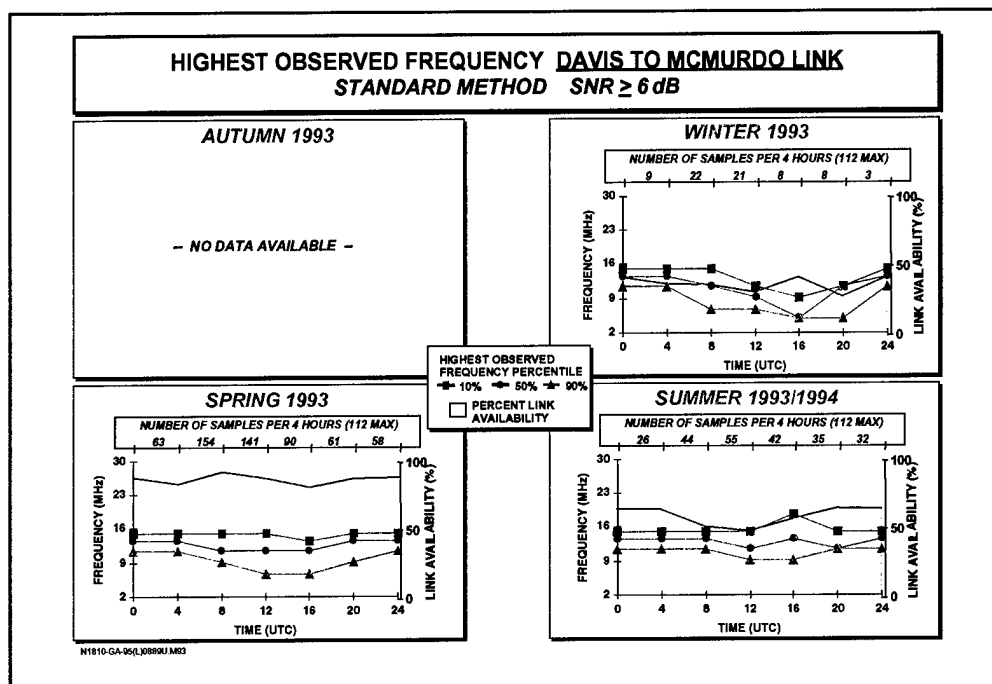


Figure 176. Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-McMurdo Link by Season, 1993 (6-dB Minimum Measured SINAD)

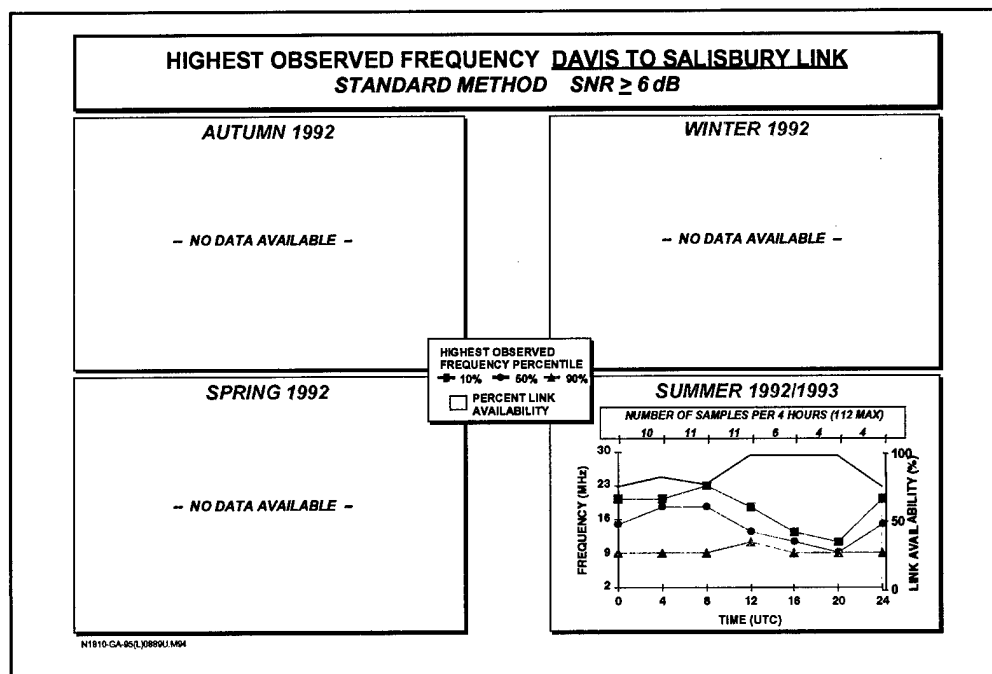


Figure 177. Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-Salisbury Link by Season, 1992 (6-dB Minimum Measured SINAD)

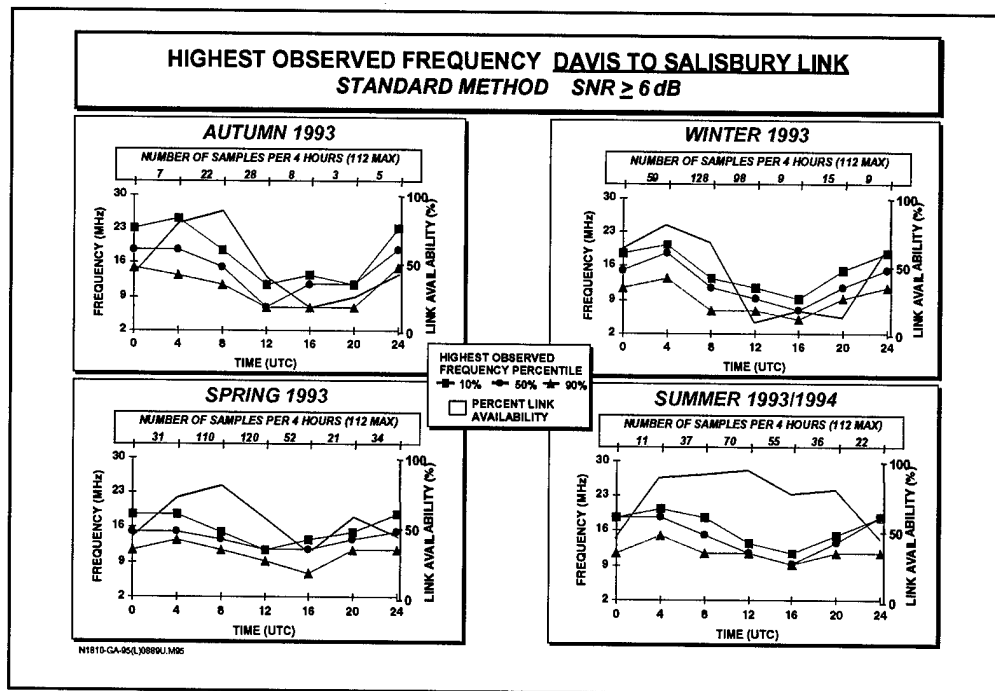


Figure 178. Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-Salisbury Link by Season, 1993 (6-dB Minimum Measured SINAD)

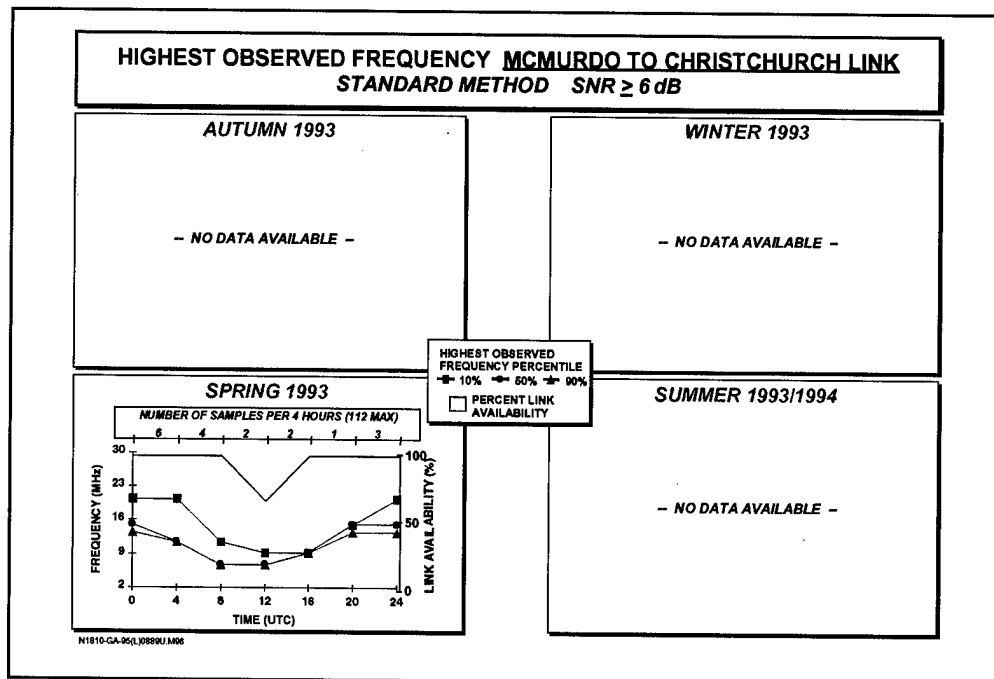


Figure 179. Exceedance (90%, 50%, and 10%) for Best Frequency, McMurdo-to-Christchurch Link by Season, 1993 (6-dB Minimum Measured SINAD)

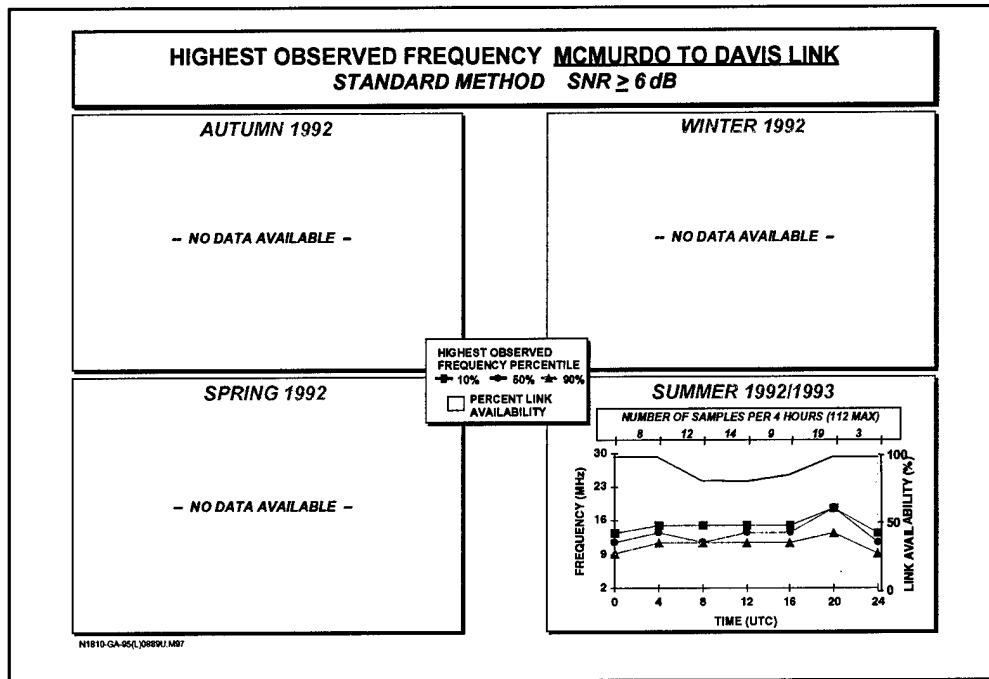


Figure 180. Exceedance (90%, 50%, and 10%) for Best Frequency, McMurdo-to-Davis Link by Season, 1992 (6-dB Minimum Measured SINAD)

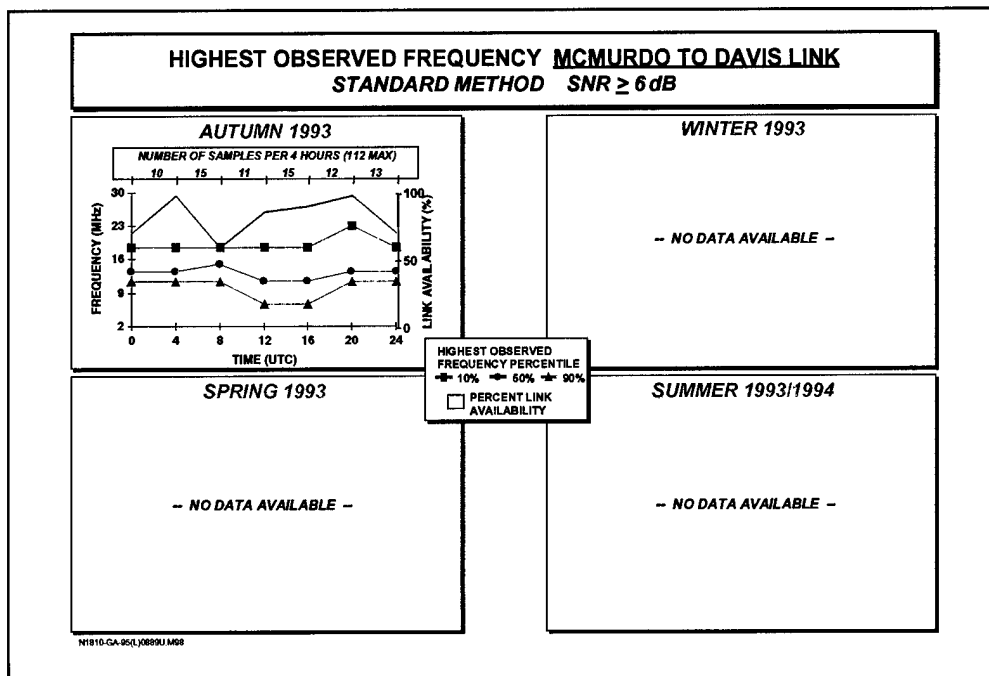


Figure 181. Exceedance (90%, 50%, and 10%) for Best Frequency, McMurdo-to-Davis Link by Season, 1993 (6-dB Minimum Measured SINAD)

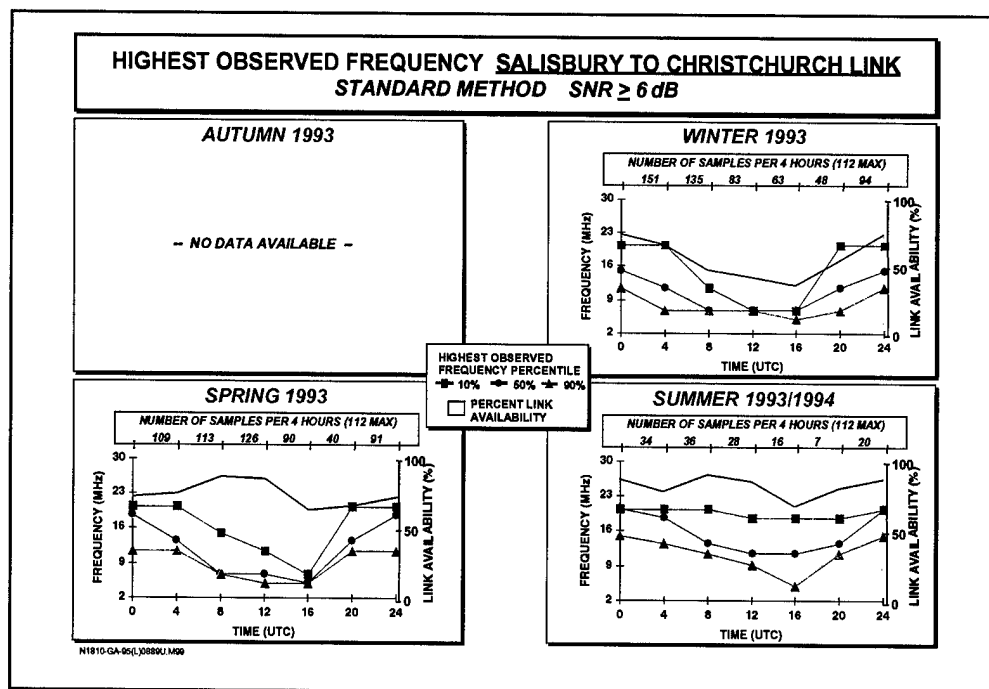


Figure 182. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Christchurch Link by Season, 1993 (6-dB Minimum Measured SINAD)

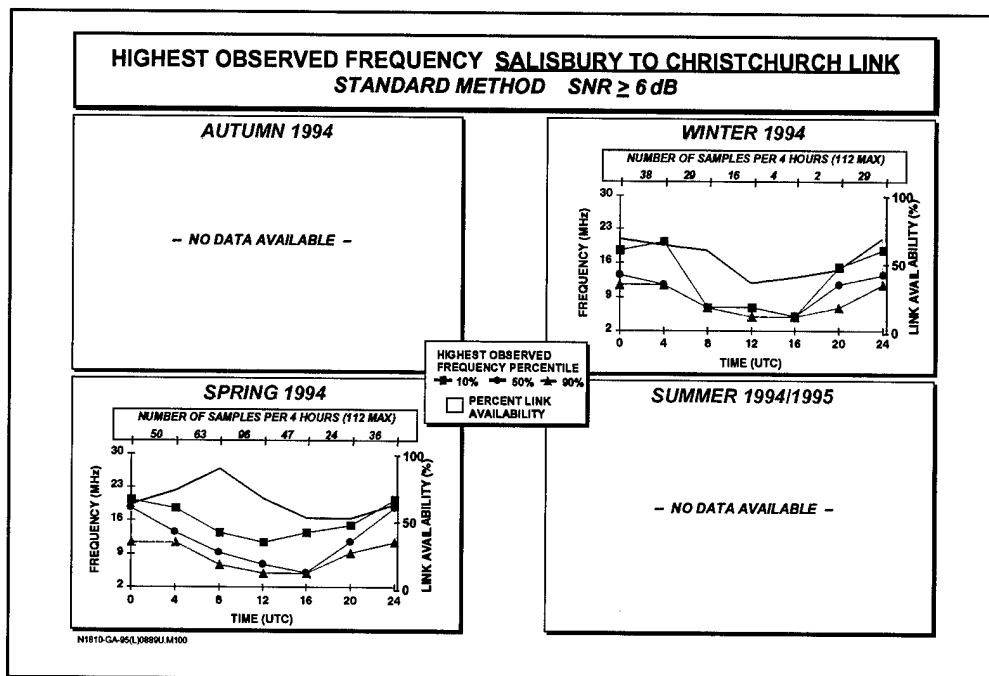


Figure 183. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Christchurch Link by Season, 1994 (6-dB Minimum Measured SINAD)

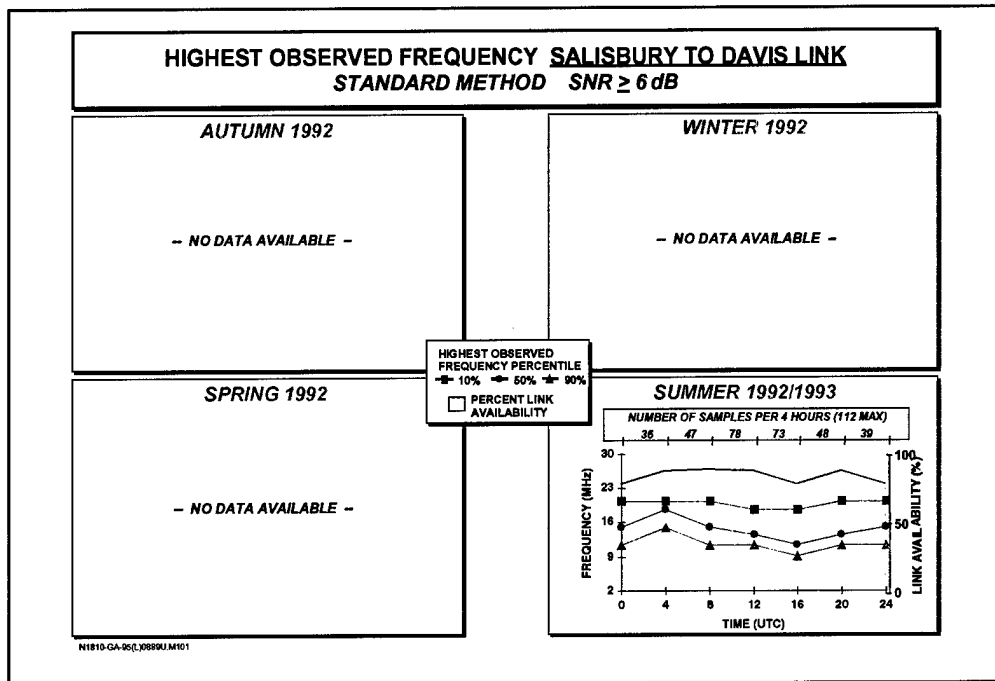


Figure 184. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Davis Link by Season, 1992 (6-dB Minimum Measured SINAD)

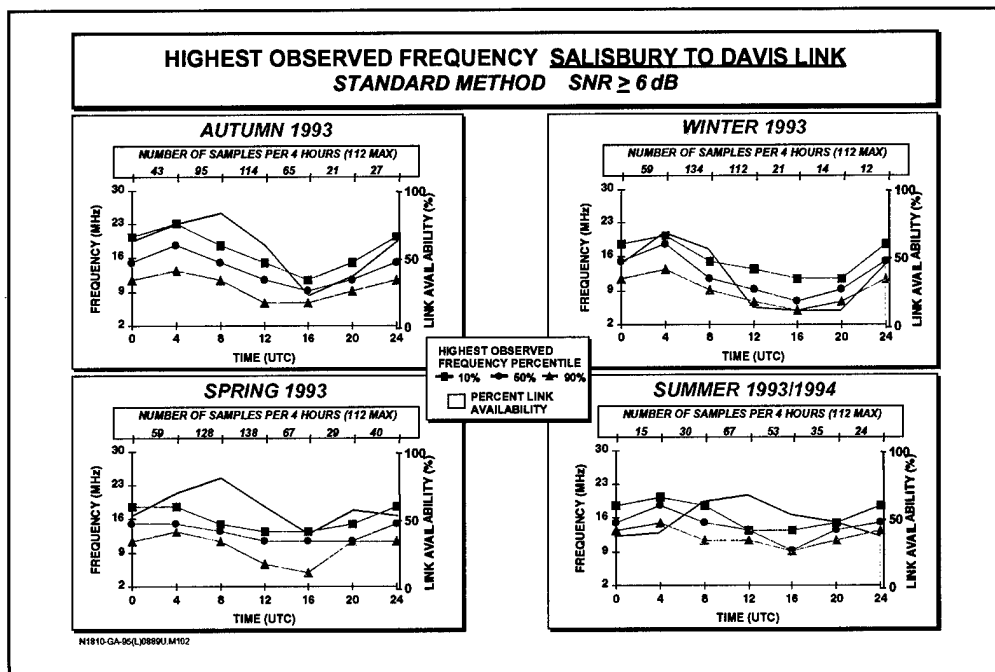


Figure 185. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Davis Link by Season, 1993 (6-dB Minimum Measured SINAD)

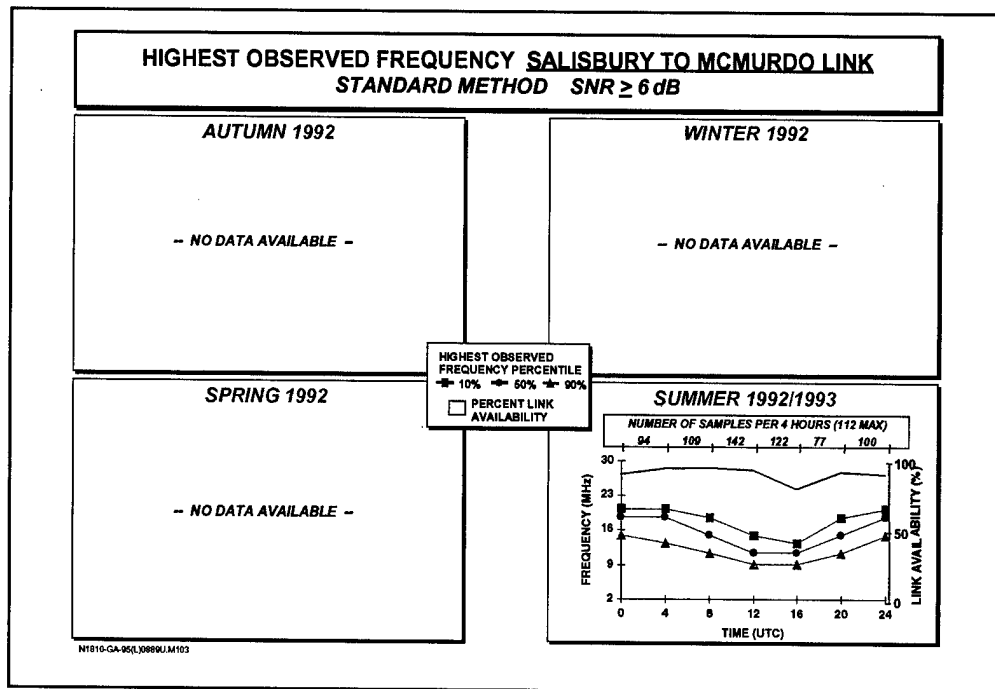


Figure 186. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Season, 1992 (6-dB Minimum Measured SINAD)

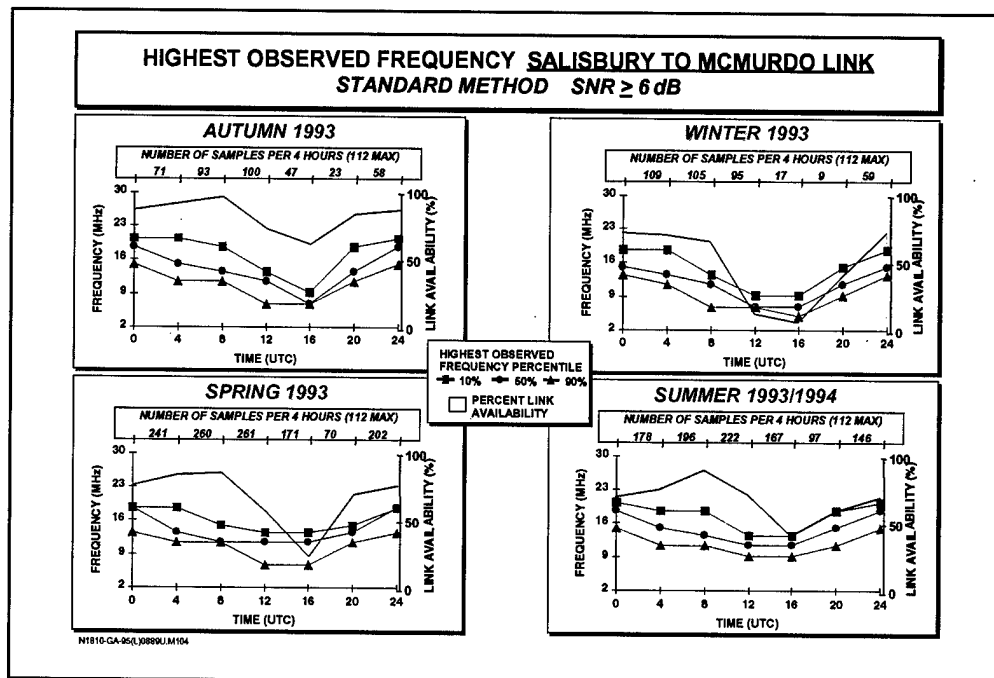


Figure 187. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Season, 1993 (6-dB Minimum Measured SINAD)

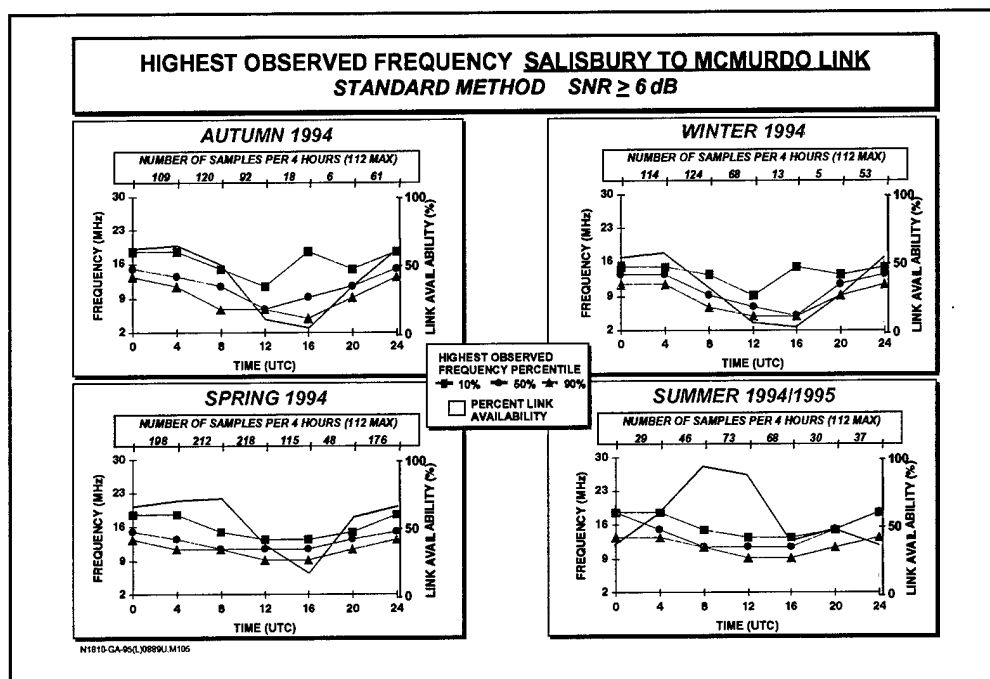


Figure 188. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Season, 1994 (6-dB Minimum Measured SINAD)

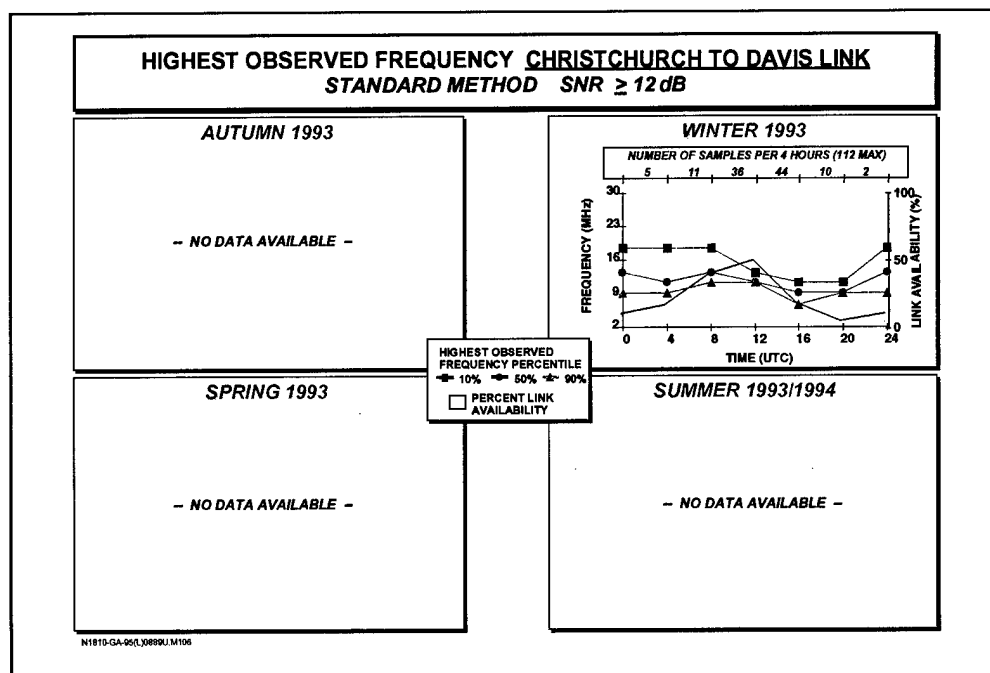


Figure 189. Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-Davis Link by Season, 1993 (12-dB Minimum Measured SINAD)

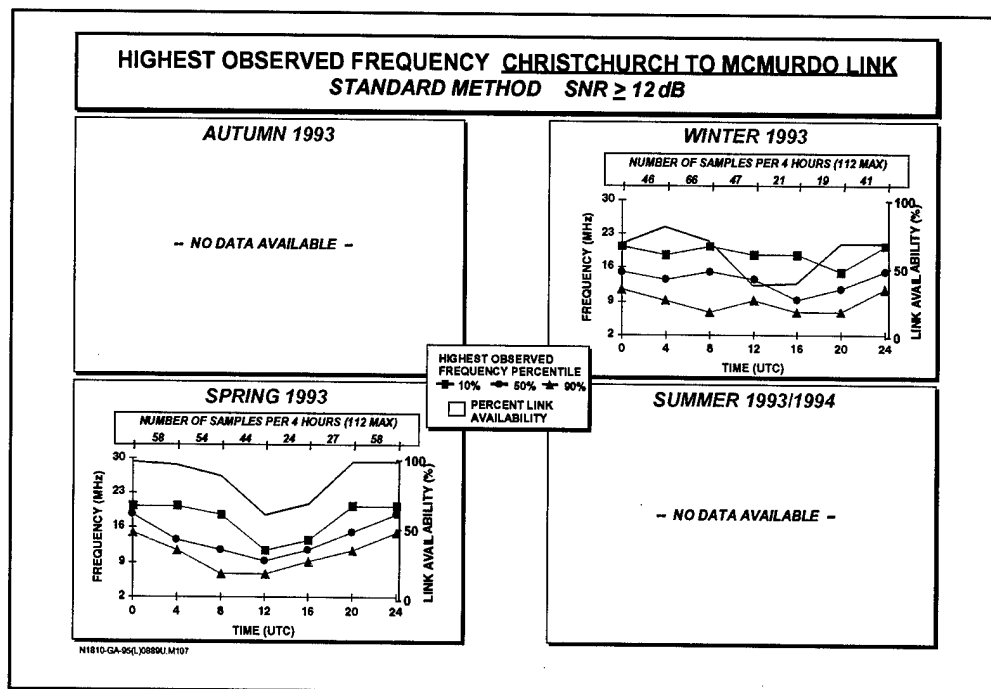


Figure 190. Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-McMurdo Link by Season, 1993 (12-dB Minimum Measured SINAD)

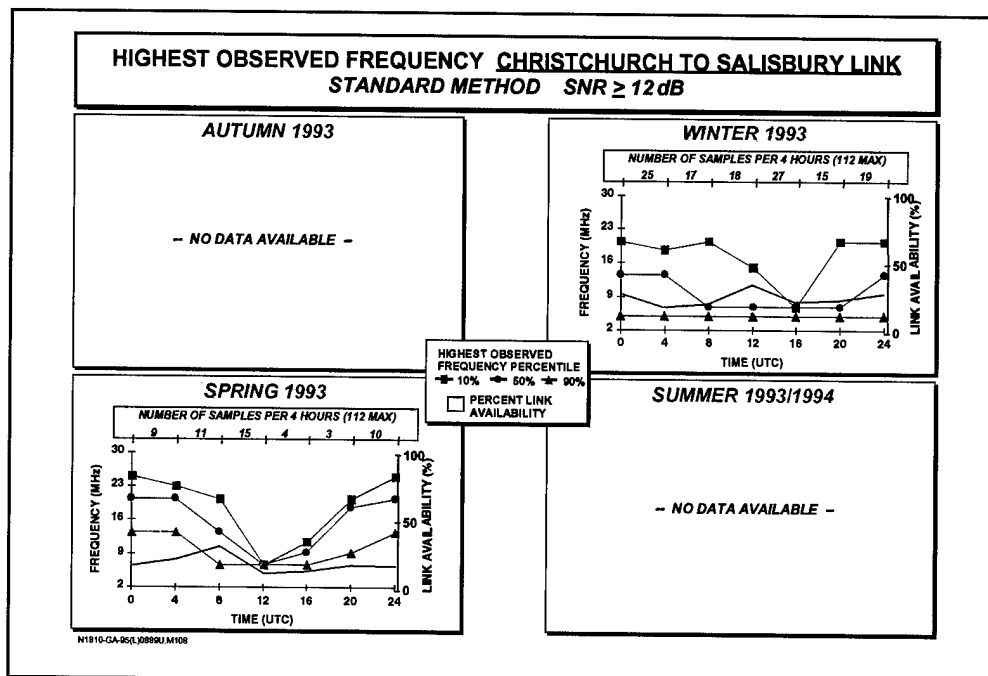


Figure 191. Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-Salisbury Link by Season, 1993 (12-dB Minimum Measured SINAD)

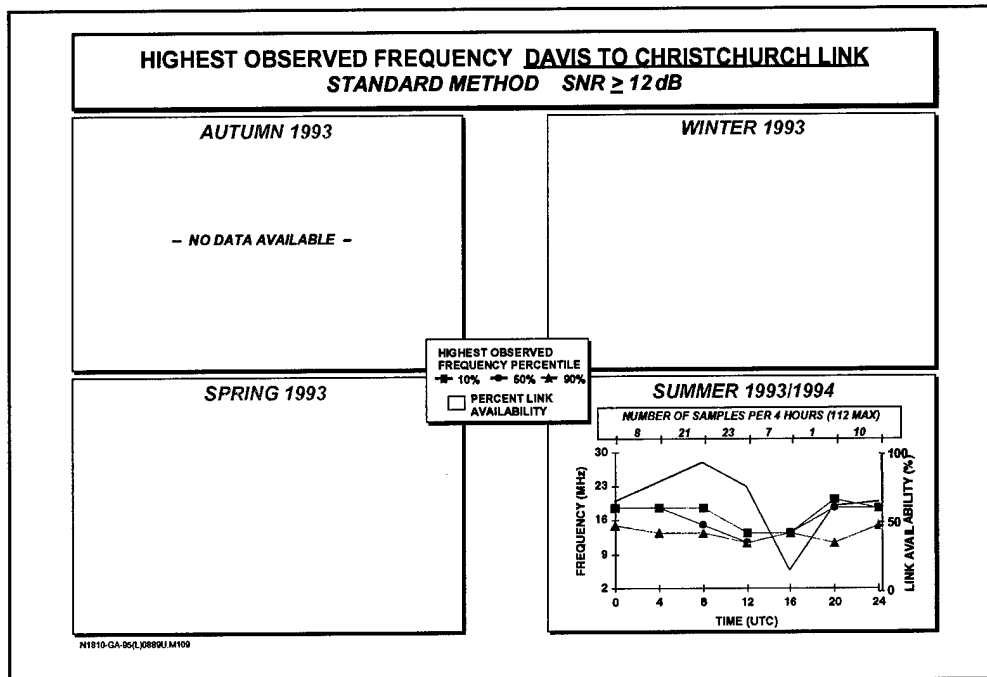


Figure 192. Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-Christchurch Link by Season, 1993 (12-dB Minimum Measured SINAD)

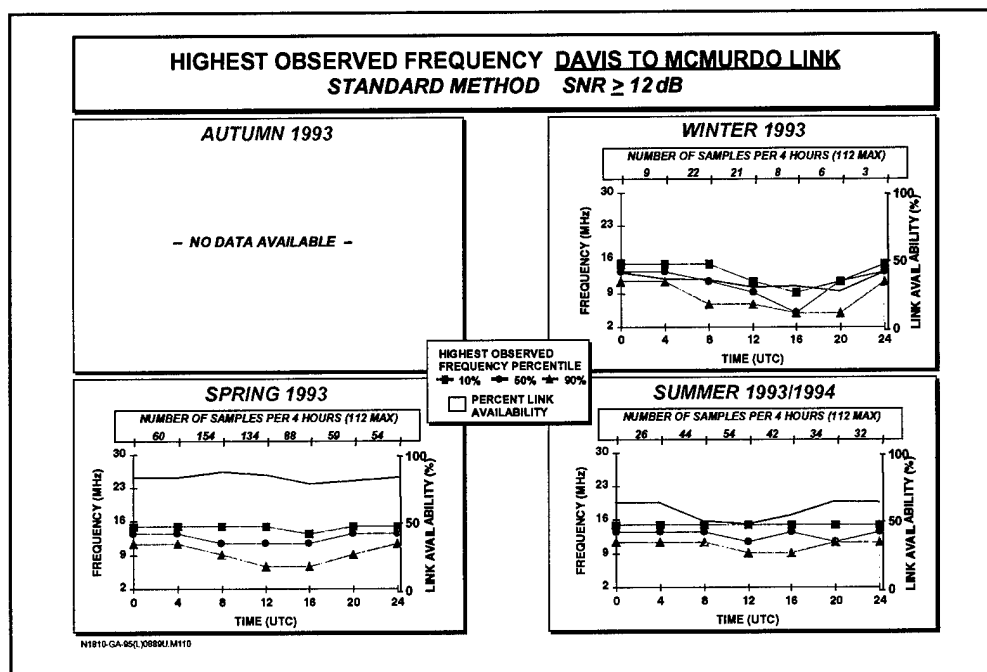


Figure 193. Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-McMurdo Link by Season, 1993 (12-dB Minimum Measured SINAD)

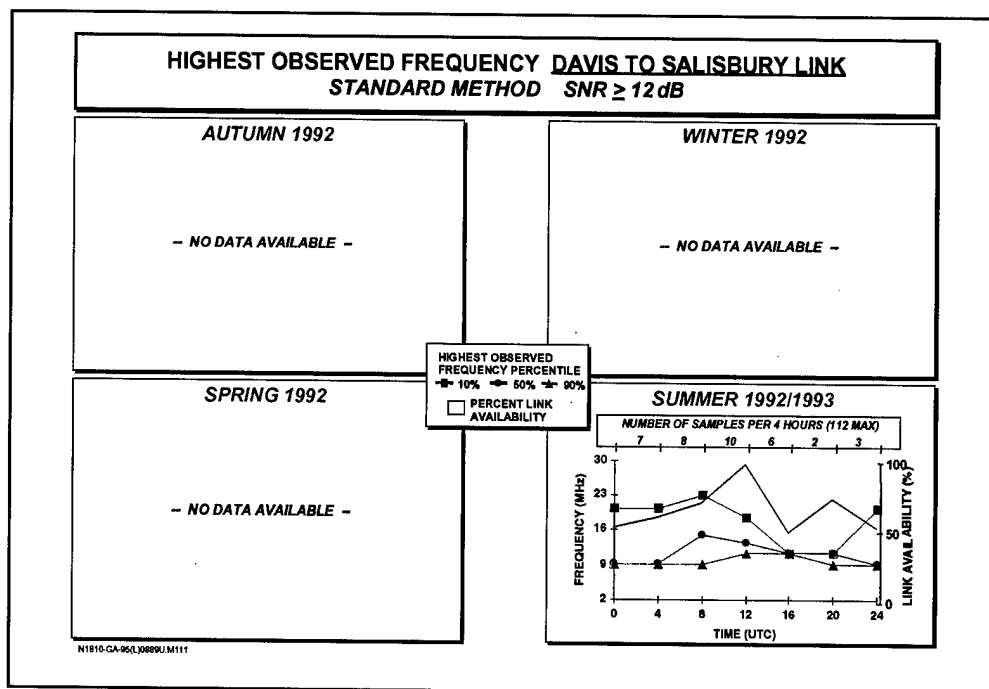


Figure 194. Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-Salisbury Link by Season, 1992 (12-dB Minimum Measured SINAD)

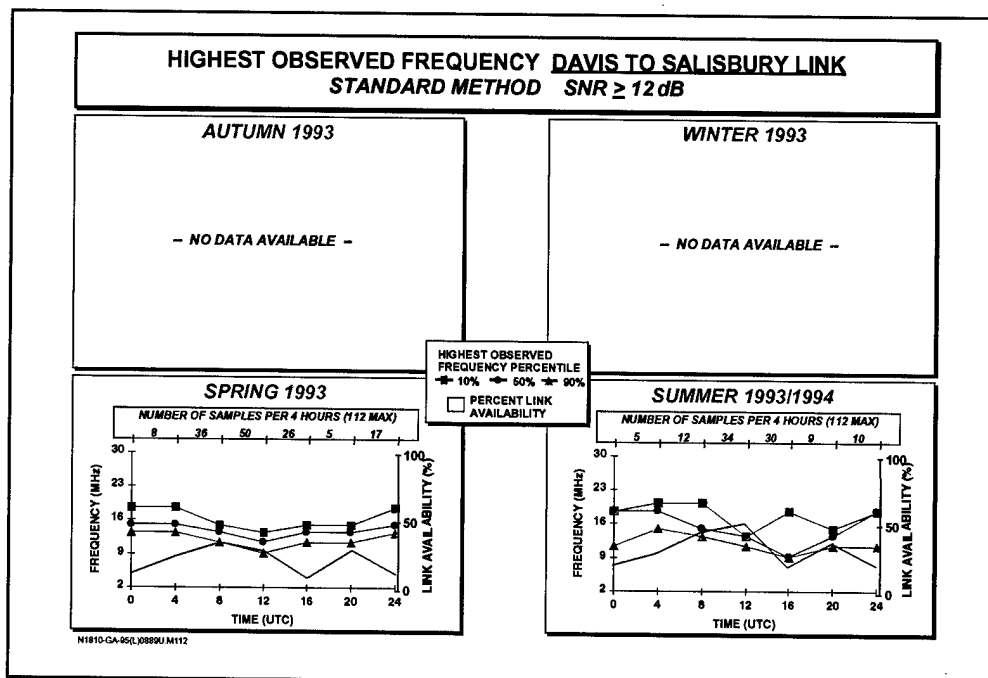


Figure 195. Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-Salisbury Link by Season, 1993 (12-dB Minimum Measured SINAD)

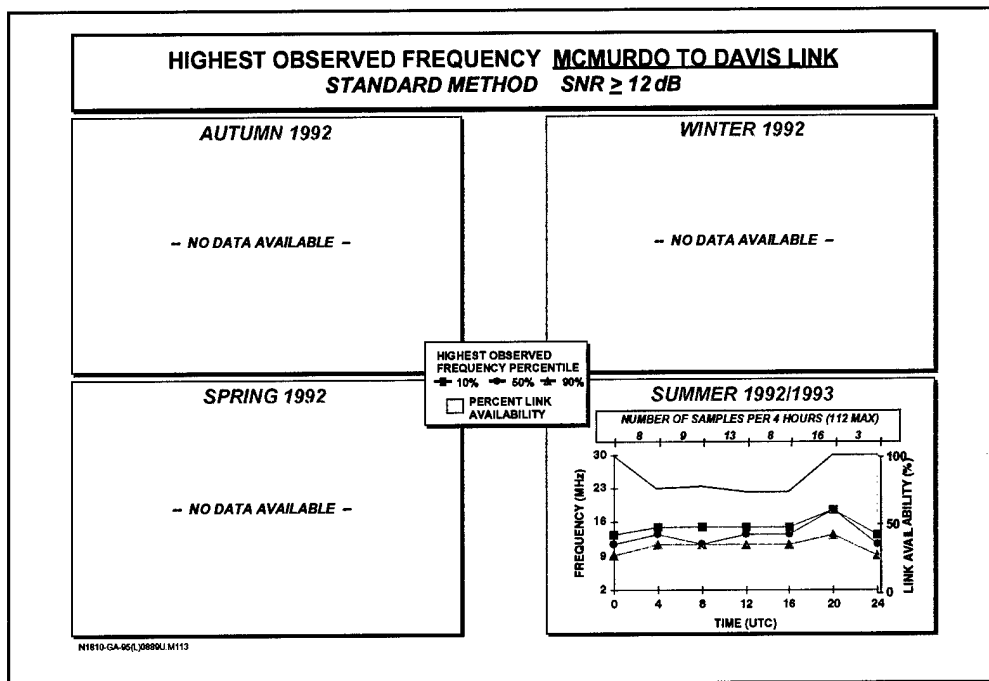


Figure 196. Exceedance (90%, 50%, and 10%) for Best Frequency, McMurdo-to-Davis Link by Season, 1992 (12-dB Minimum Measured SINAD)

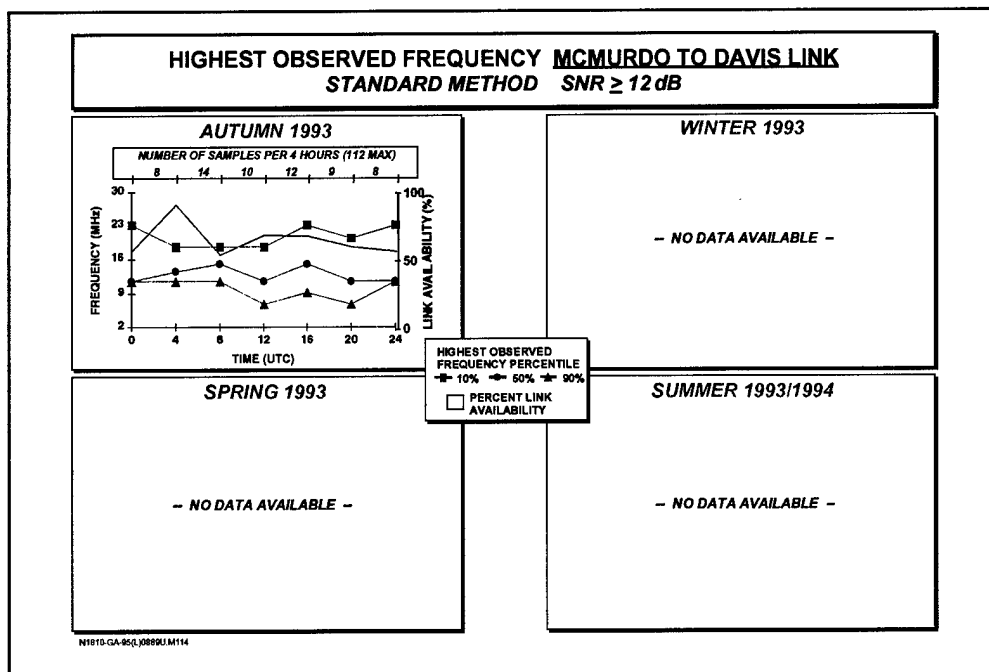


Figure 197. Exceedance (90%, 50%, and 10%) for Best Frequency, McMurdo-to-Davis Link by Season, 1993 (12-dB Minimum Measured SINAD)

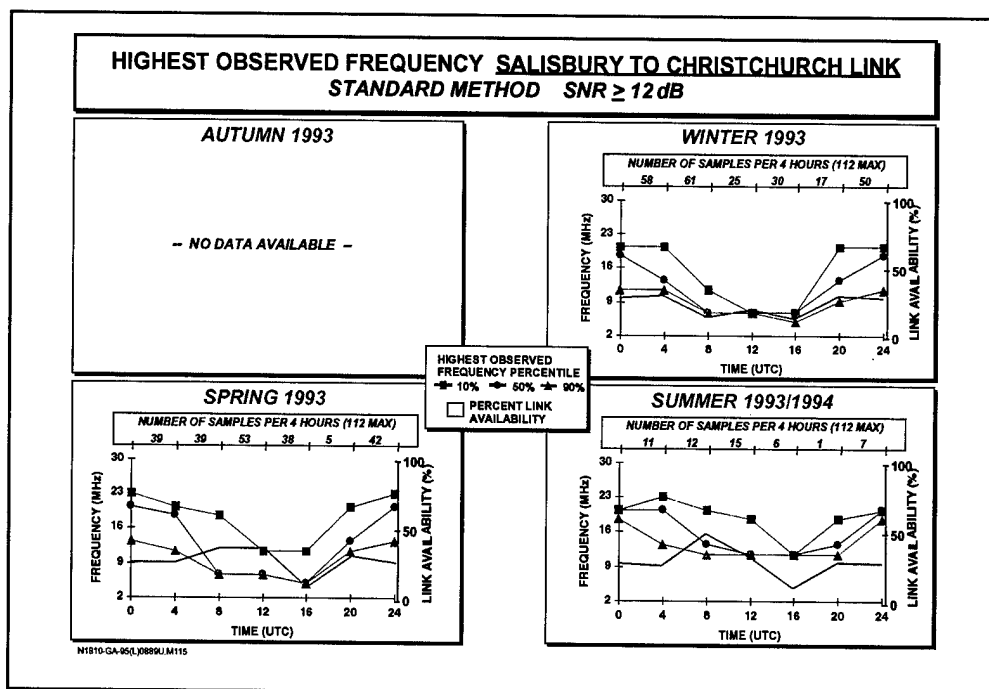


Figure 198. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Christchurch Link by Season, 1993 (12-dB Minimum Measured SINAD)

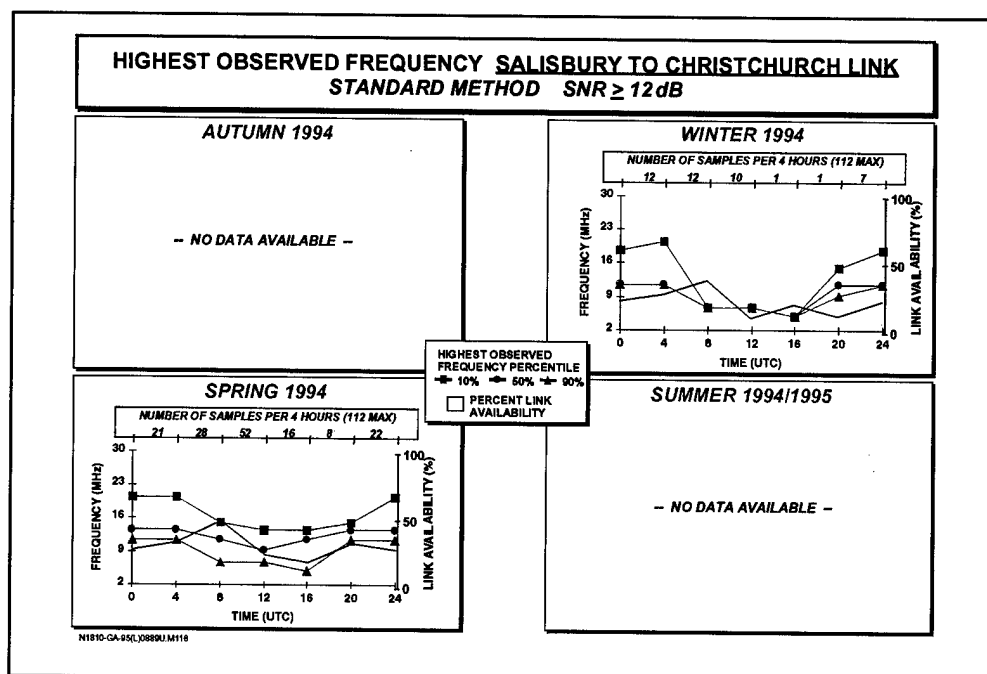


Figure 199. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Christchurch Link by Season, 1994 (12-dB Minimum Measured SINAD)

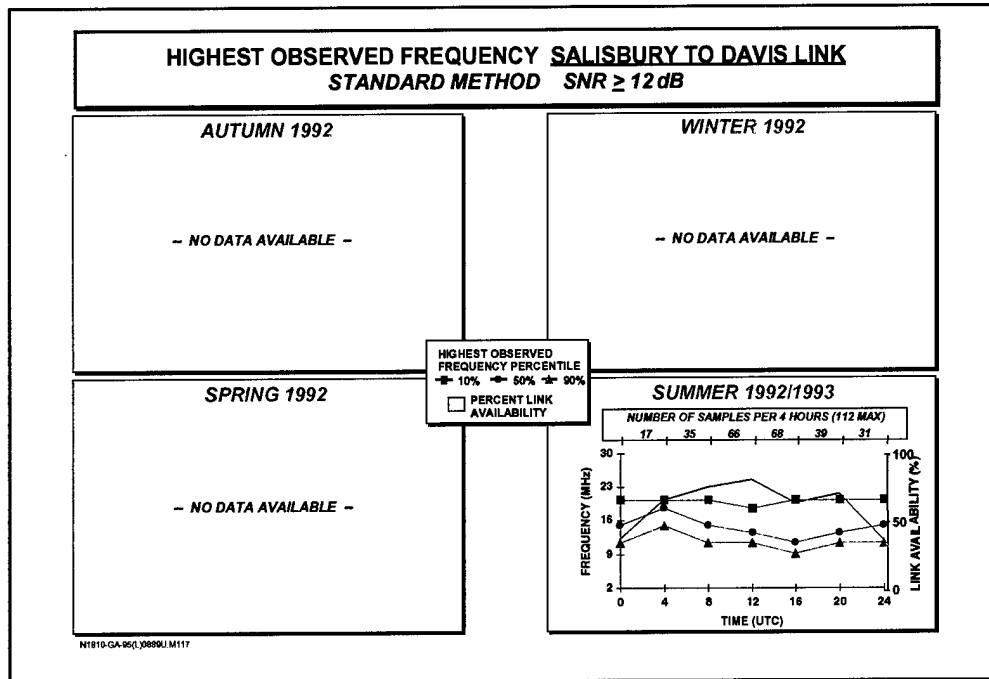


Figure 200. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Davis Link by Season, 1992 (12-dB Minimum Measured SINAD)

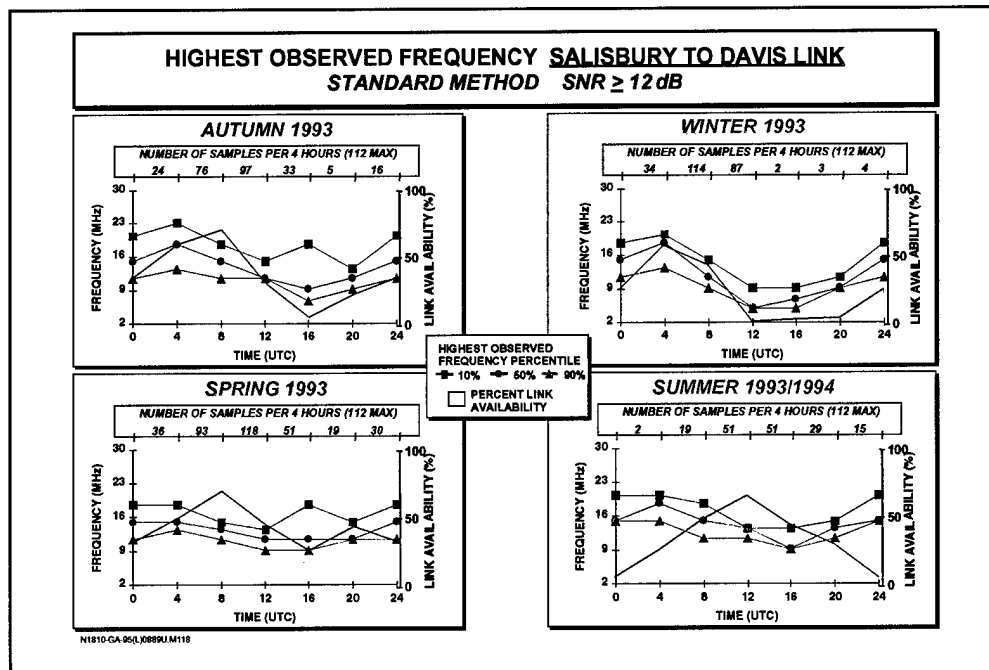


Figure 201. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Davis Link by Season, 1993 (12-dB Minimum Measured SINAD)

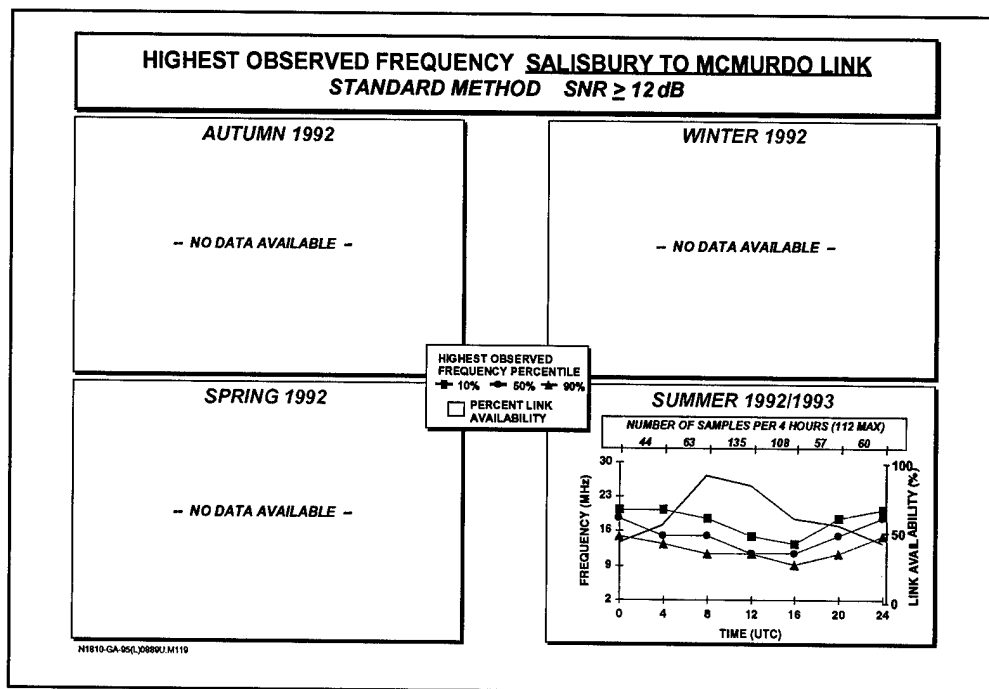


Figure 202. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Season, 1992 (12-dB Minimum Measured SINAD)

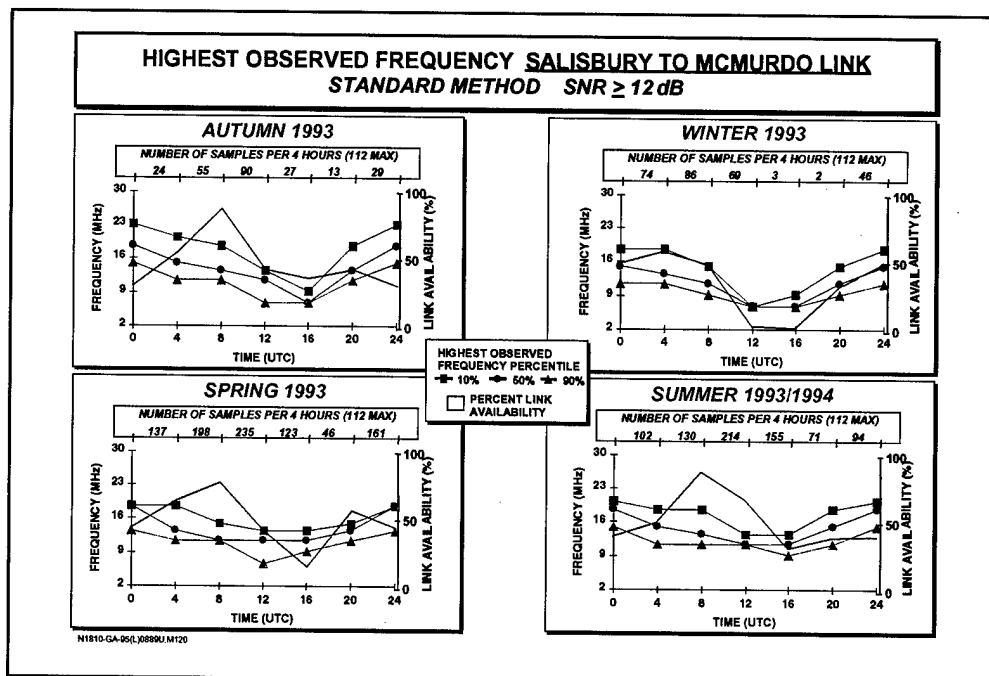


Figure 203. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Season, 1993 (12-dB Minimum Measured SINAD)

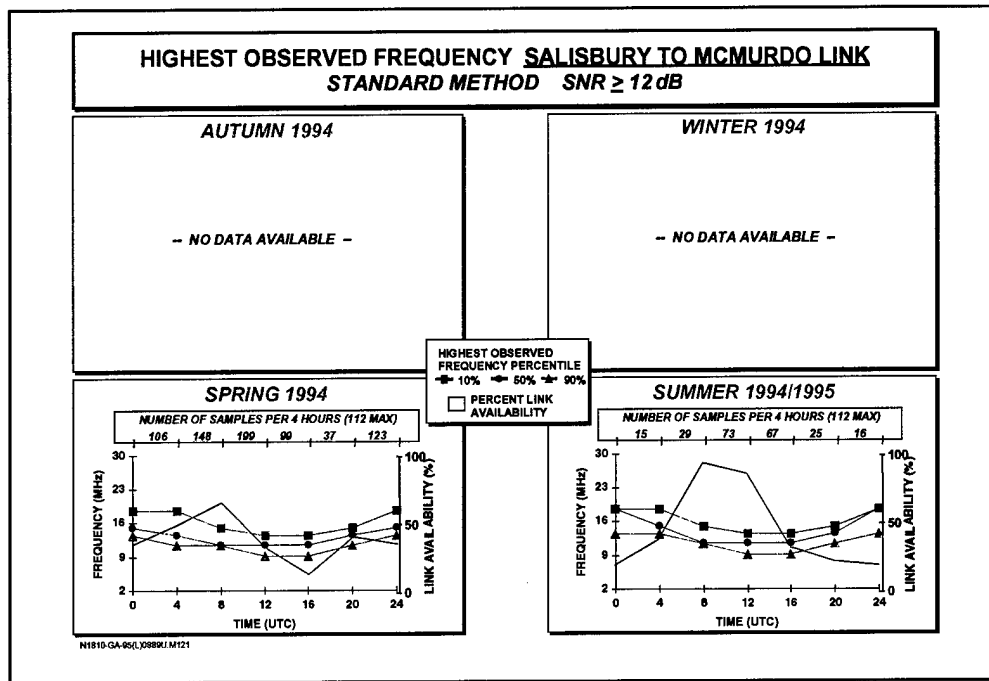


Figure 204. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Season, 1994 (12-dB Minimum Measured SINAD)

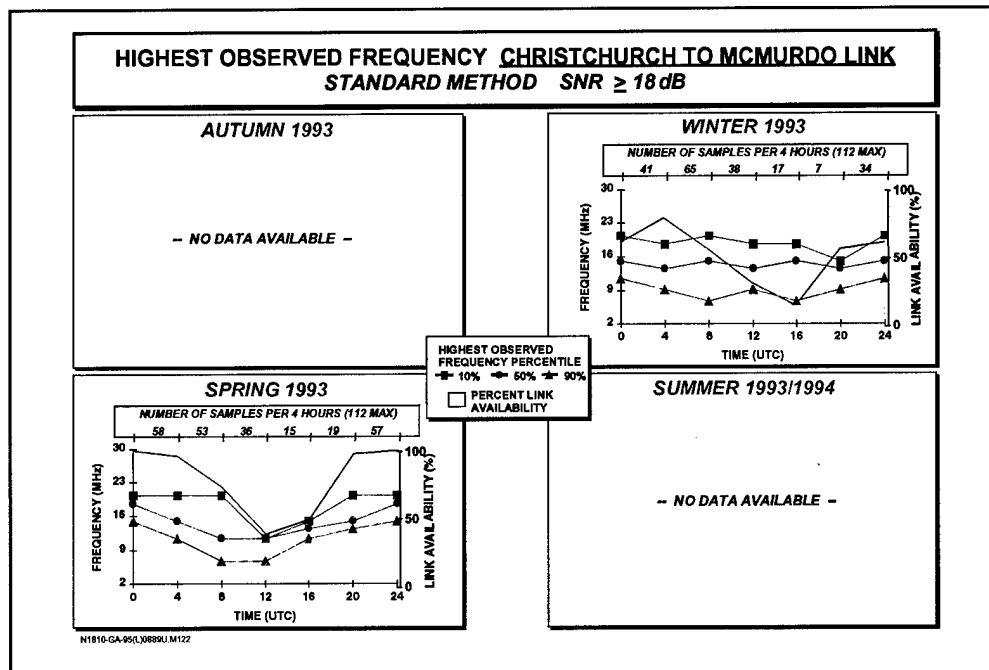


Figure 205. Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-McMurdo Link by Season, 1993 (18-dB Minimum Measured SINAD)

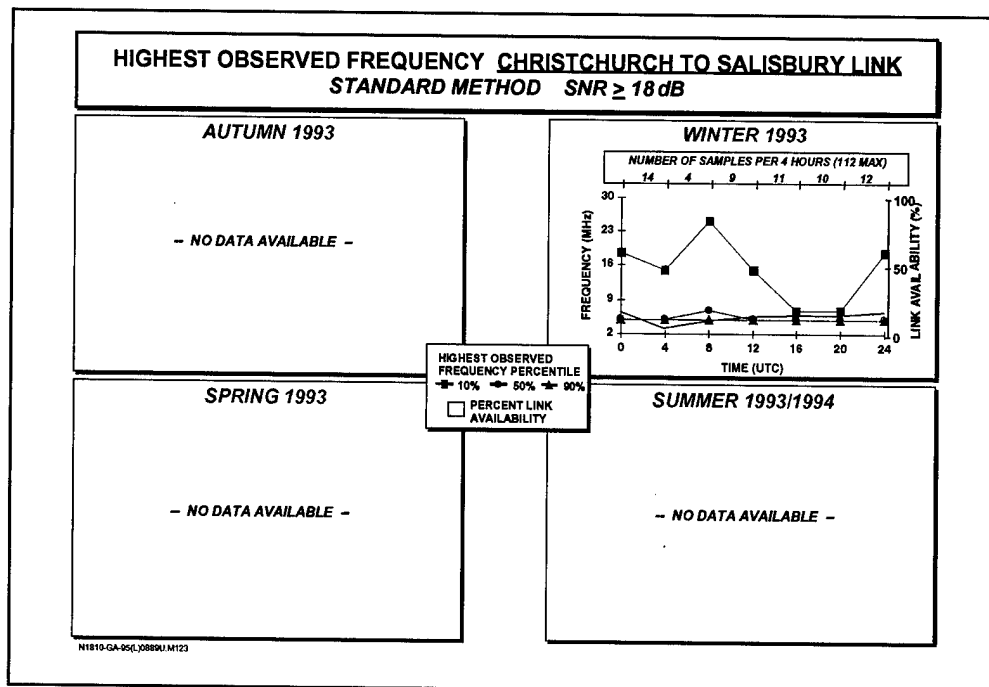


Figure 206. Exceedance (90%, 50%, and 10%) for Best Frequency, Christchurch-to-Salisbury Link by Season, 1993 (18-dB Minimum Measured SINAD)

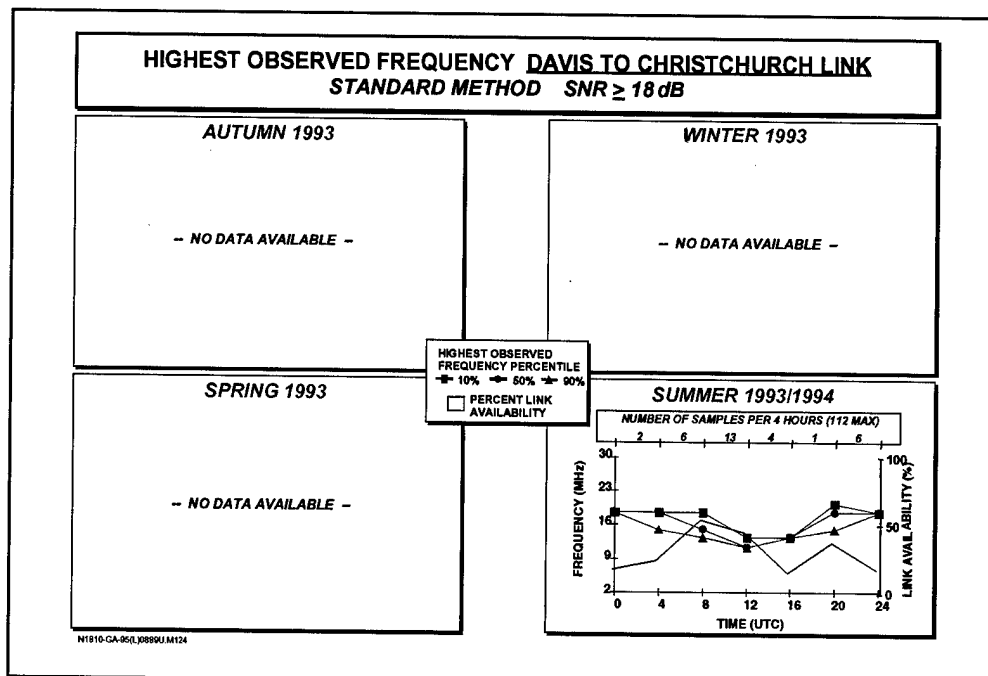


Figure 207. Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-Christchurch Link by Season, 1993 (18-dB Minimum Measured SINAD)

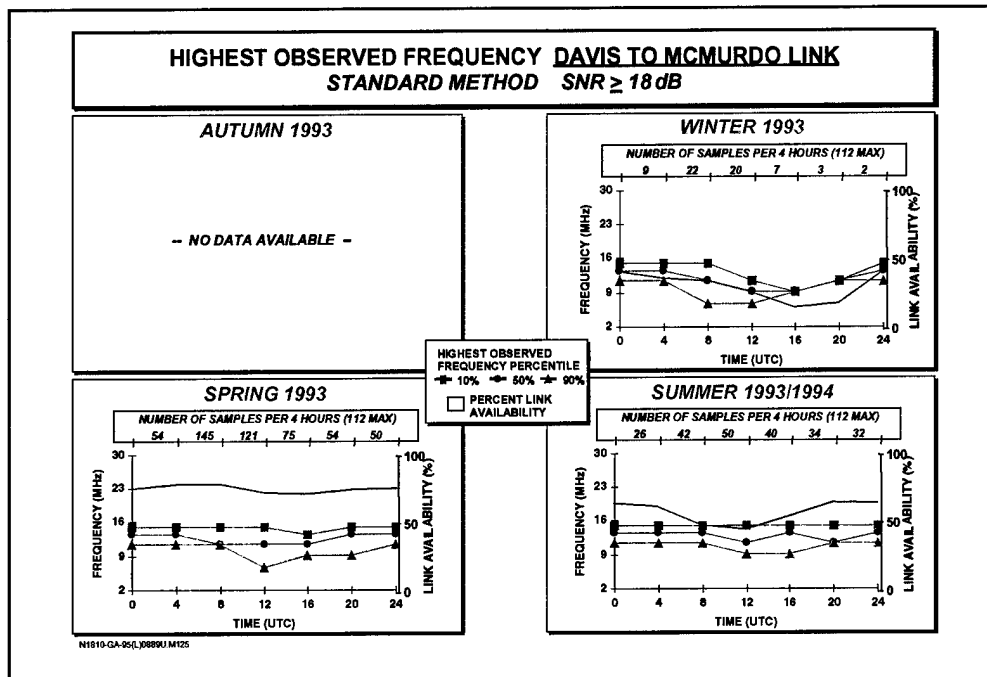


Figure 208. Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-McMurdo Link by Season, 1993 (18-dB Minimum Measured SINAD)

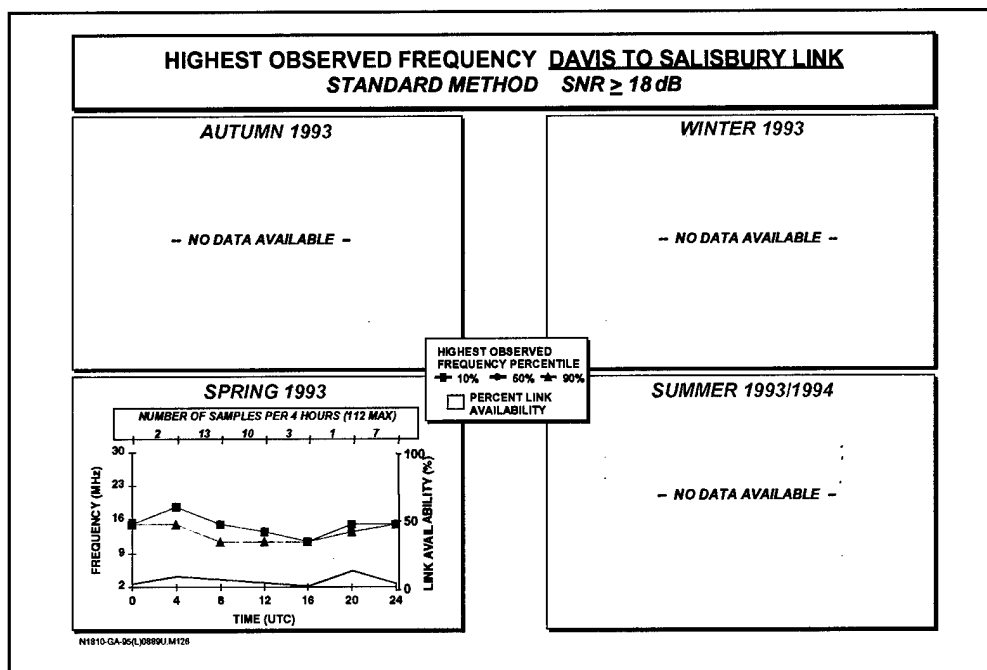


Figure 209. Exceedance (90%, 50%, and 10%) for Best Frequency, Davis-to-Salisbury Link by Season, 1993 (18-dB Minimum Measured SINAD)

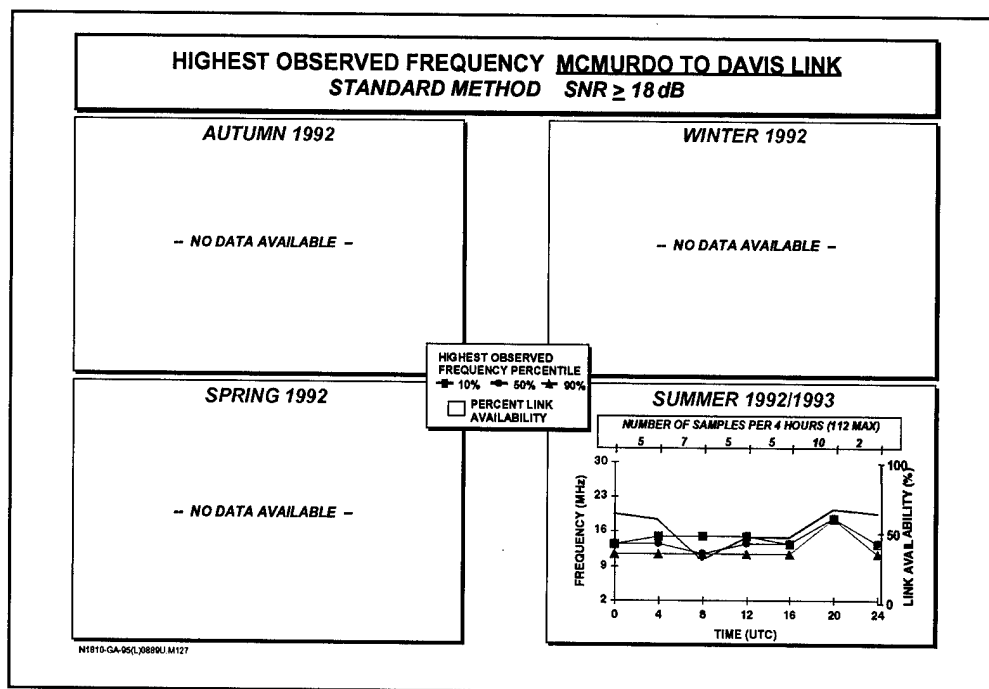


Figure 210. Exceedance (90%, 50%, and 10%) for Best Frequency, McMurdo-to-Davis Link by Season, 1992 (18-dB Minimum Measured SINAD)

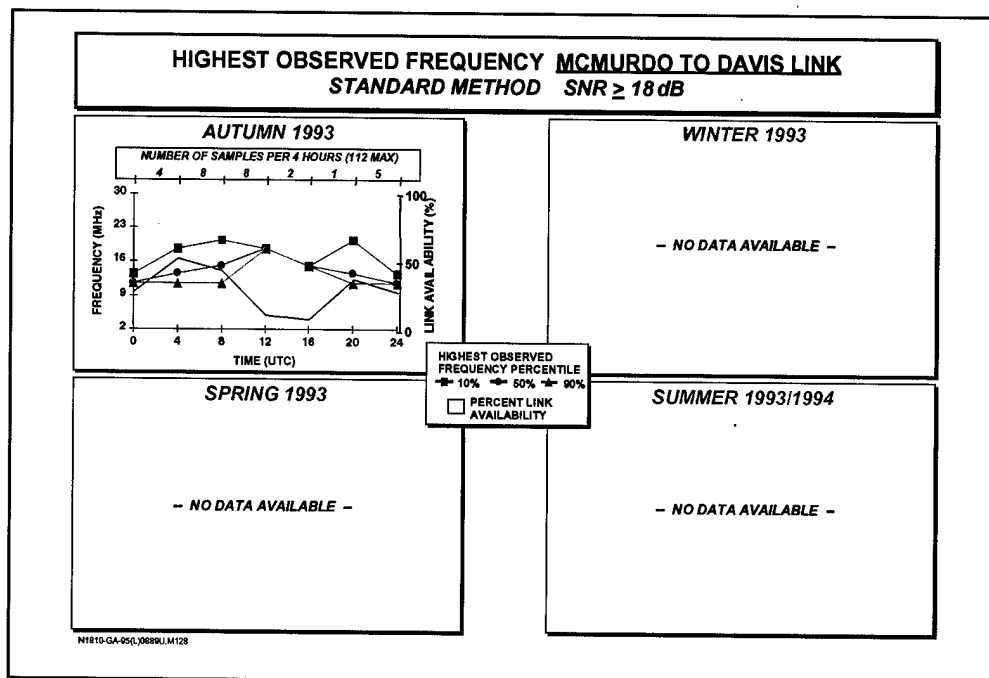


Figure 211. Exceedance (90%, 50%, and 10%) for Best Frequency, McMurdo-to-Davis Link by Season, 1993 (18-dB Minimum Measured SINAD)

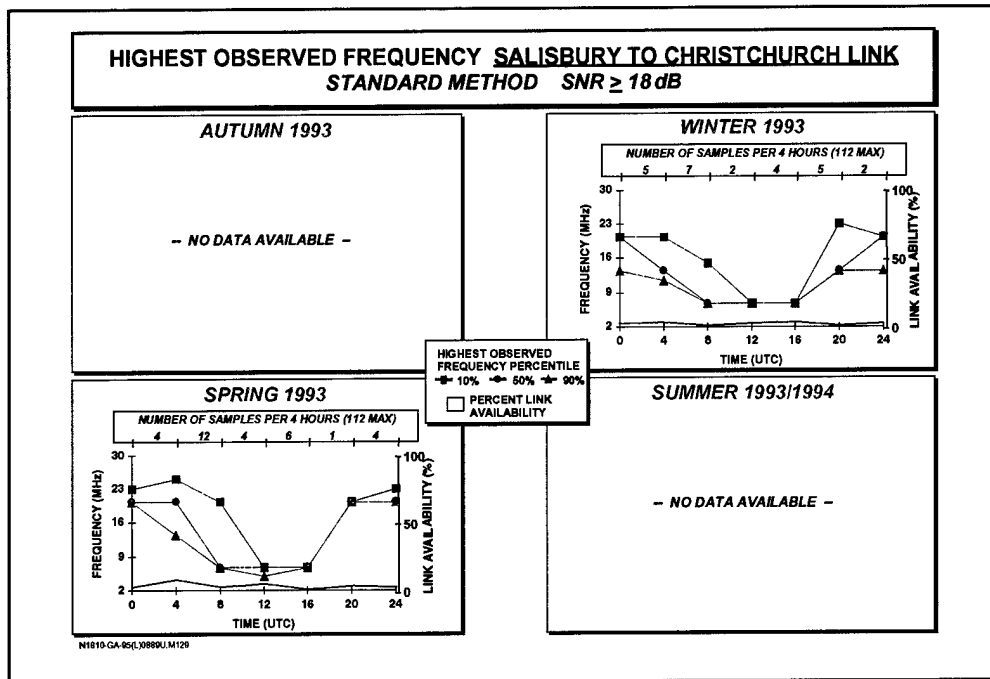


Figure 212. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Christchurch Link by Season, 1993 (18-dB Minimum Measured SINAD)

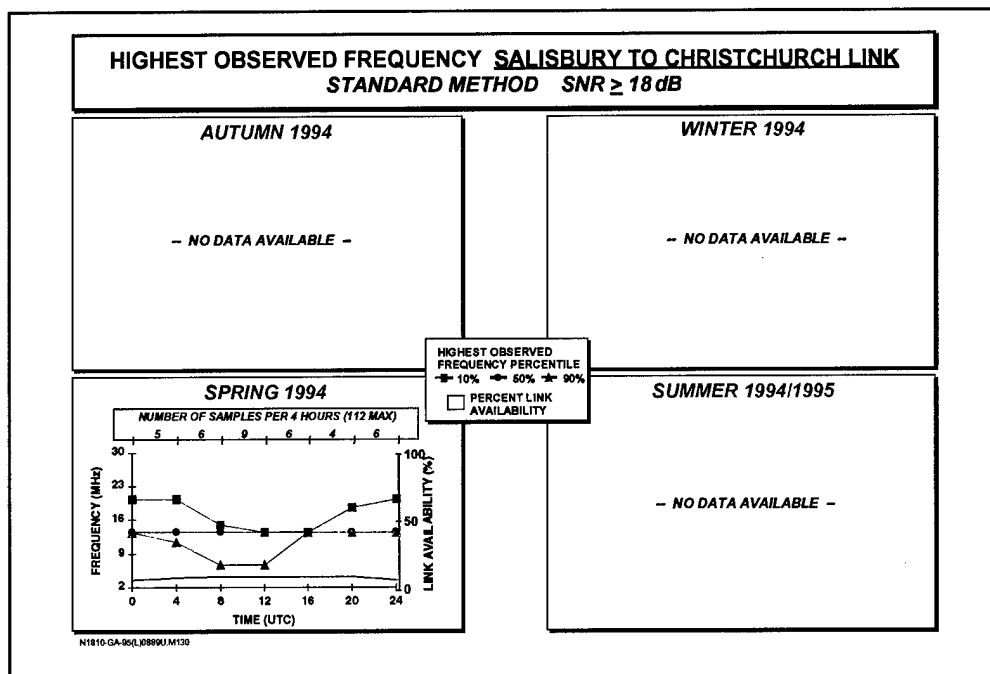


Figure 213. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Christchurch Link by Season, 1994 (18-dB Minimum Measured SINAD)

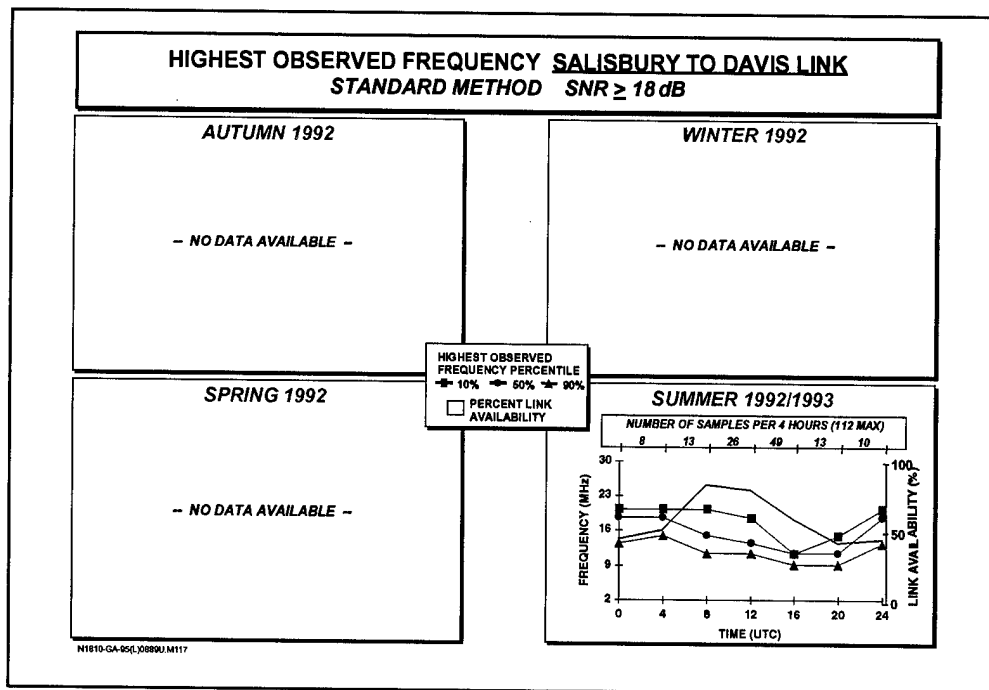


Figure 214. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Davis Link by Season, 1992 (12-dB Minimum Measured SINAD)

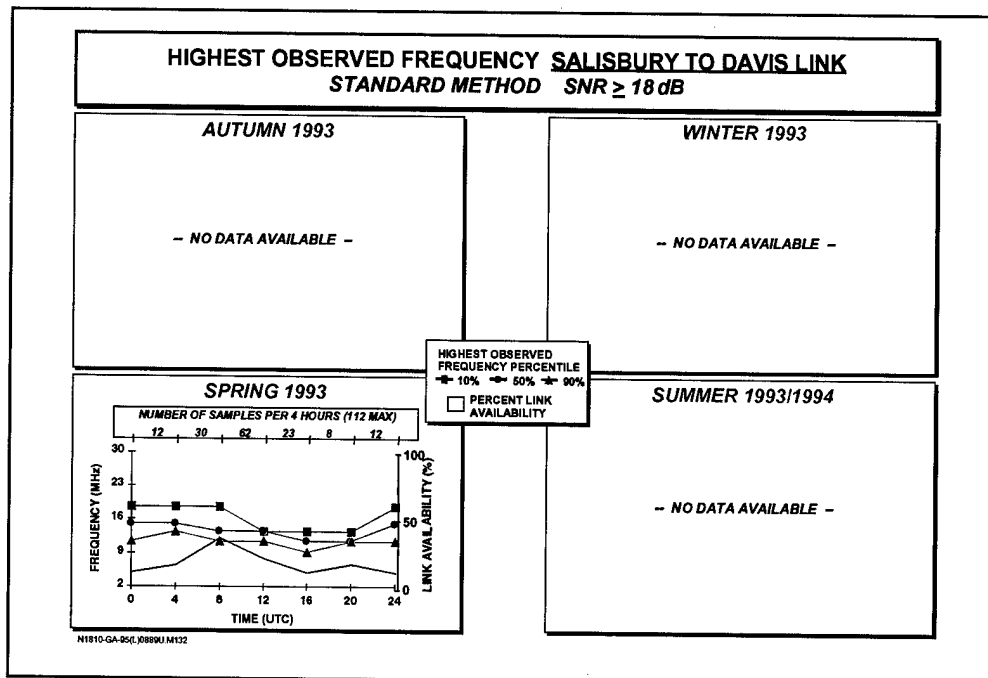


Figure 215. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-Davis Link by Season, 1993 (18-dB Minimum Measured SINAD)

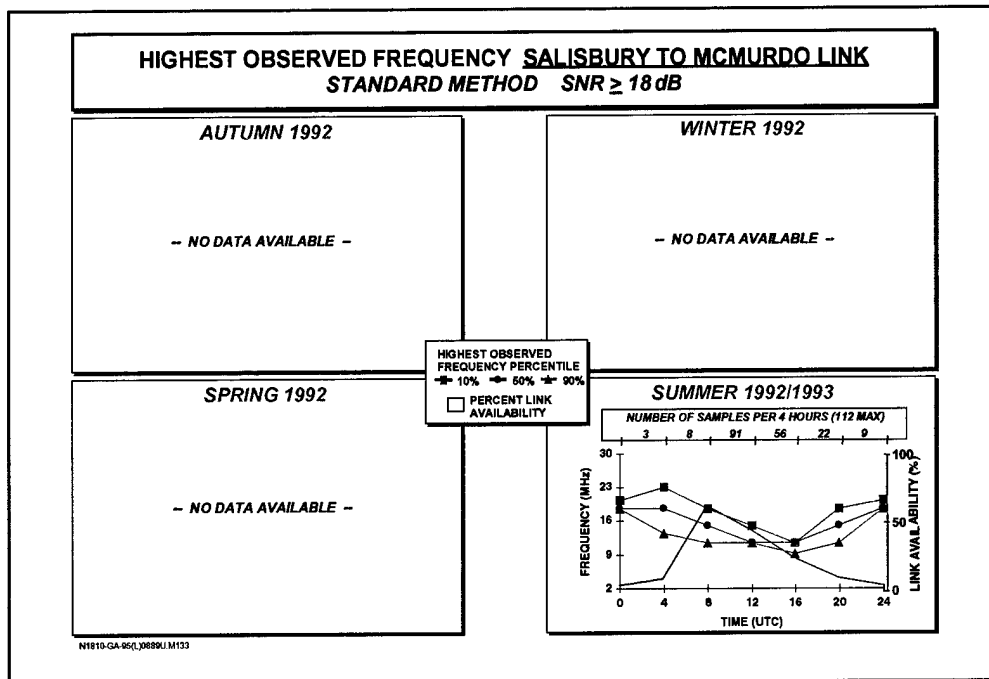


Figure 216. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Season, 1992 (18-dB Minimum Measured SINAD)

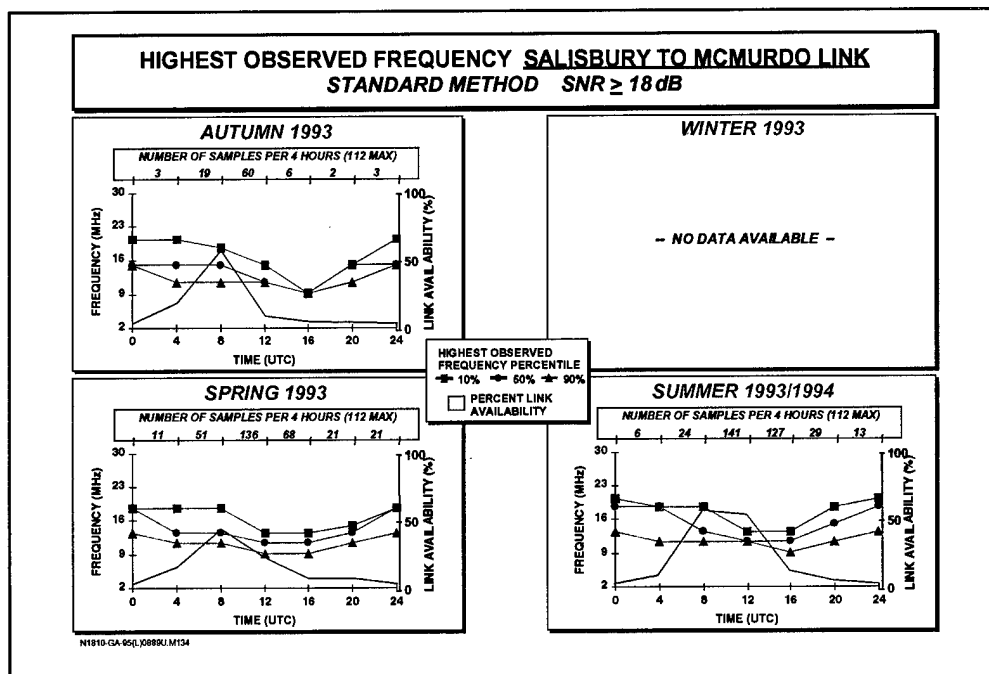


Figure 217. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Season, 1993 (18-dB Minimum Measured SINAD)

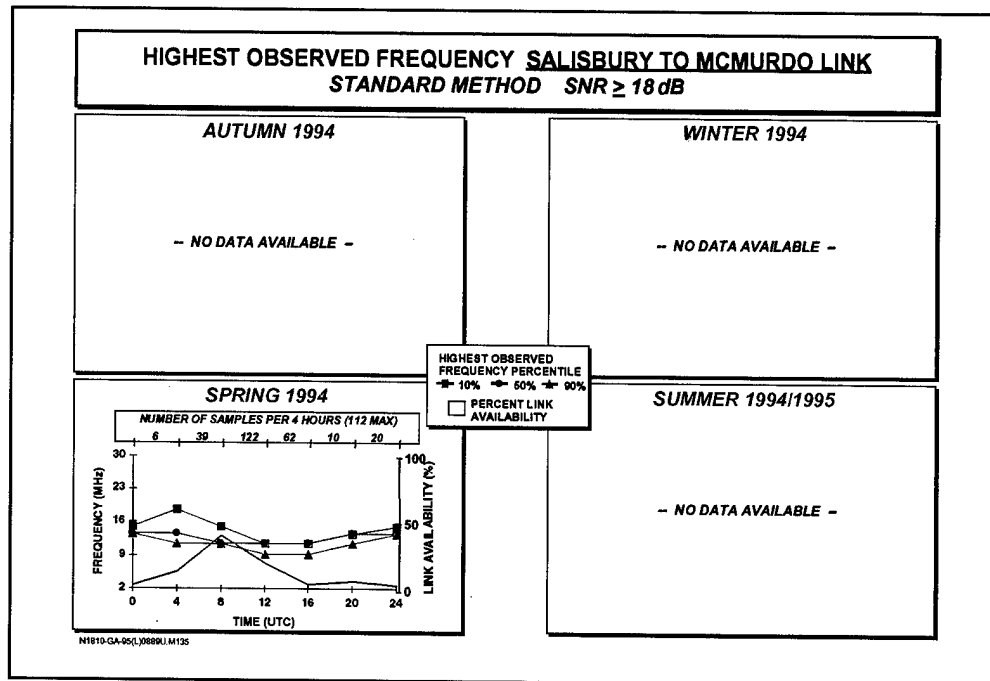


Figure 218. Exceedance (90%, 50%, and 10%) for Best Frequency, Salisbury-to-McMurdo Link by Season, 1994 (18-dB Minimum Measured SINAD)

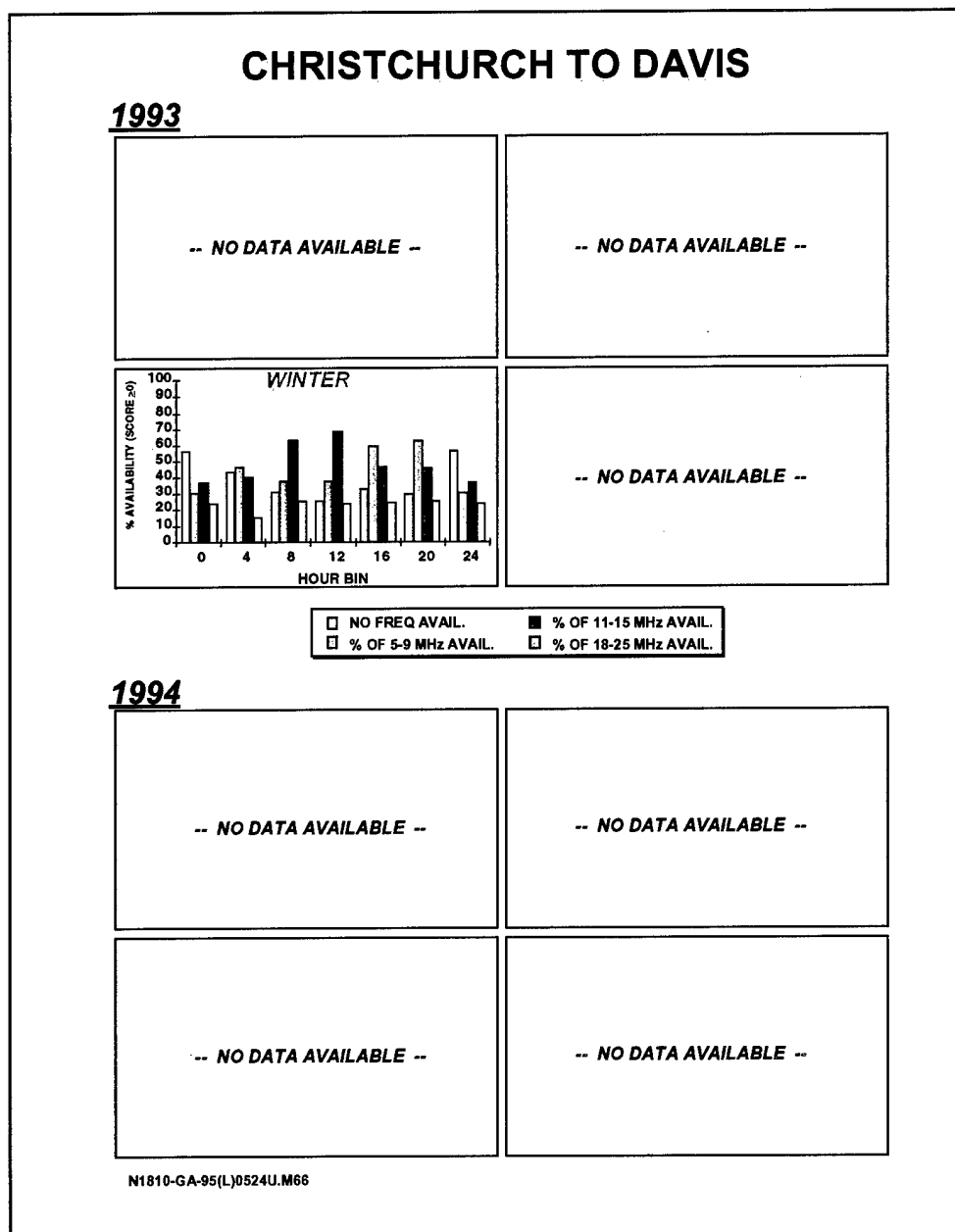


Figure 219. Circuit Availability by Season, Christchurch to Davis, 1993-1994

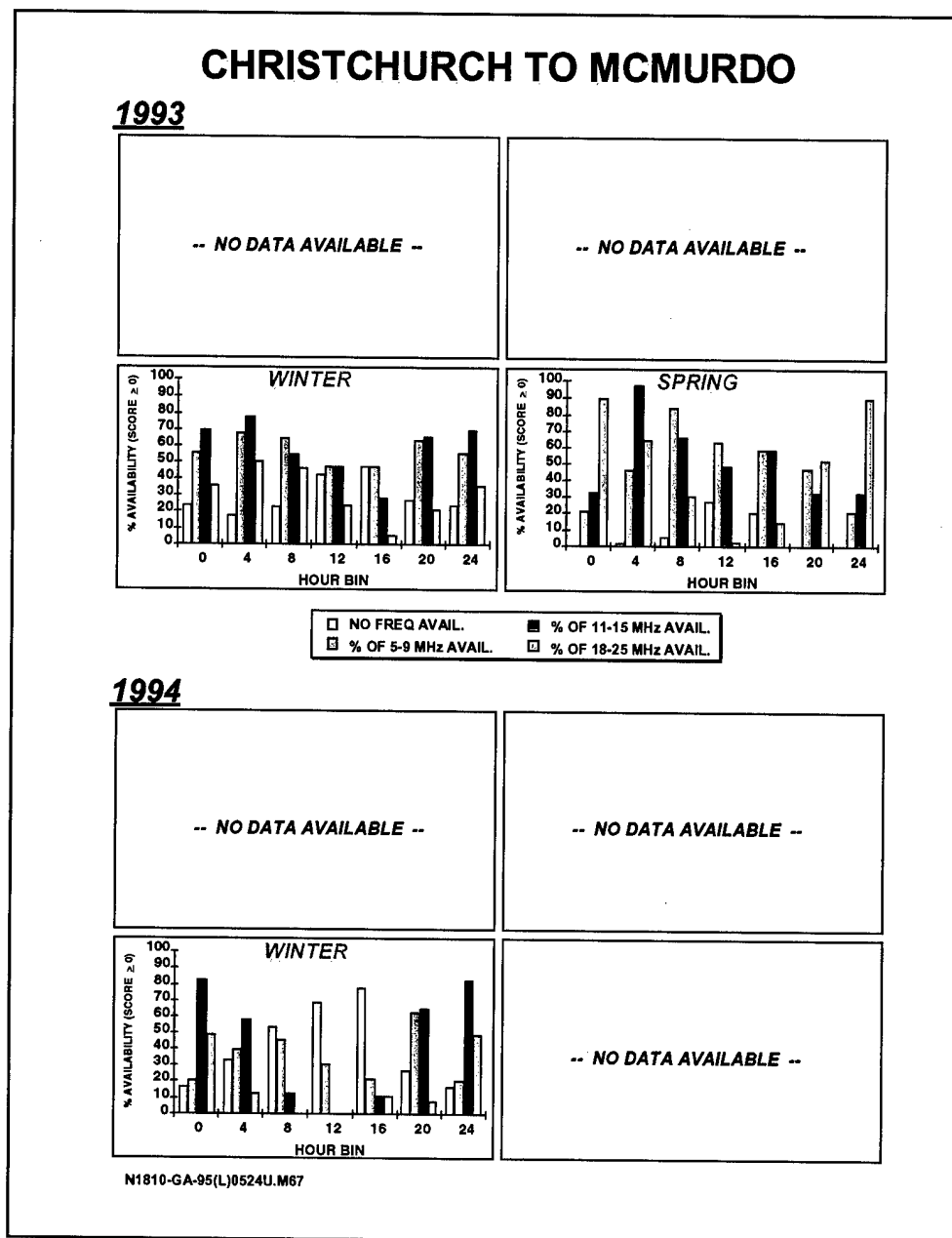
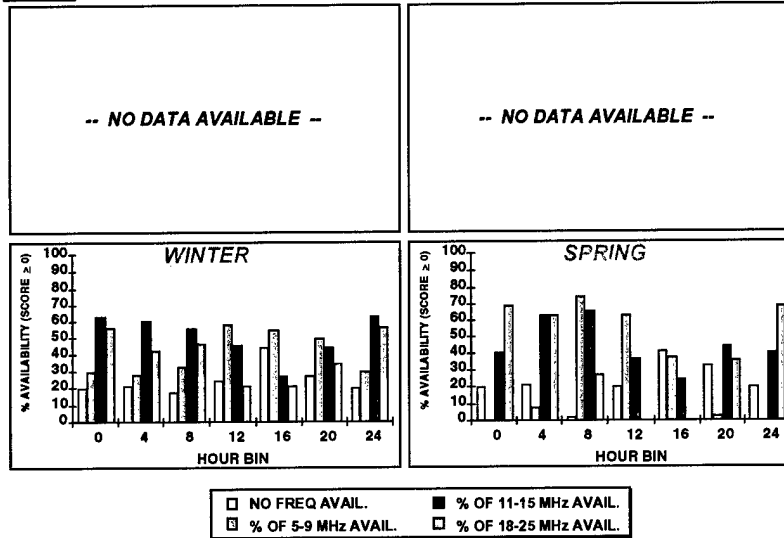


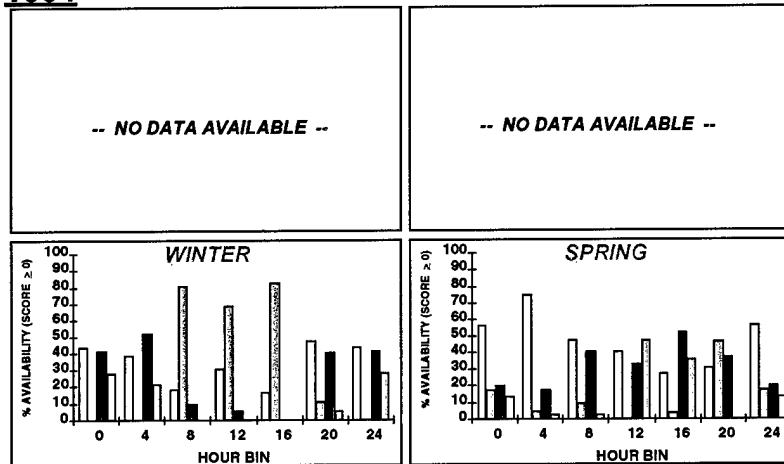
Figure 220. Circuit Availability by Season, Christchurch to McMurdo, 1993-1994

CHRISTCHURCH TO SALISBURY

1993



1994

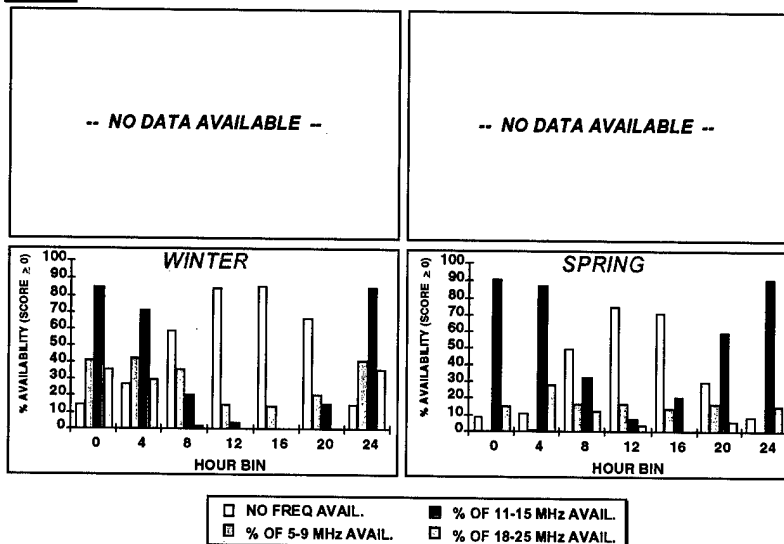


N1810-GA-95(L)0524U.M68

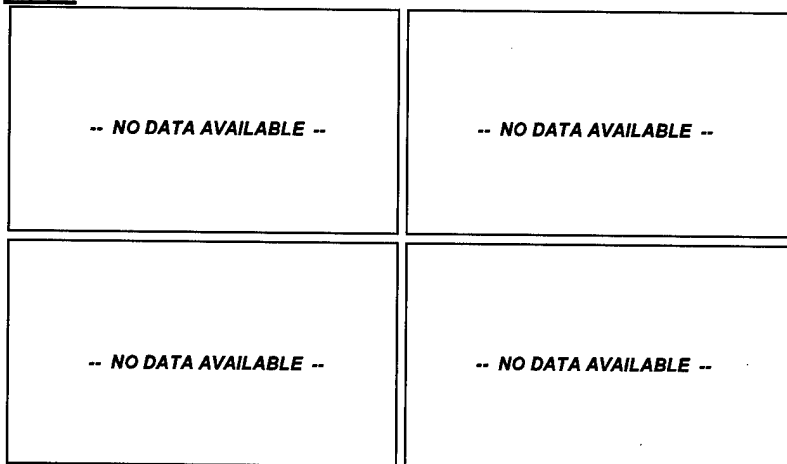
Figure 221. Circuit Availability by Season, Christchurch to Salisbury, 1993-1994

DAVIS TO CHRISTCHURCH

1993



1994

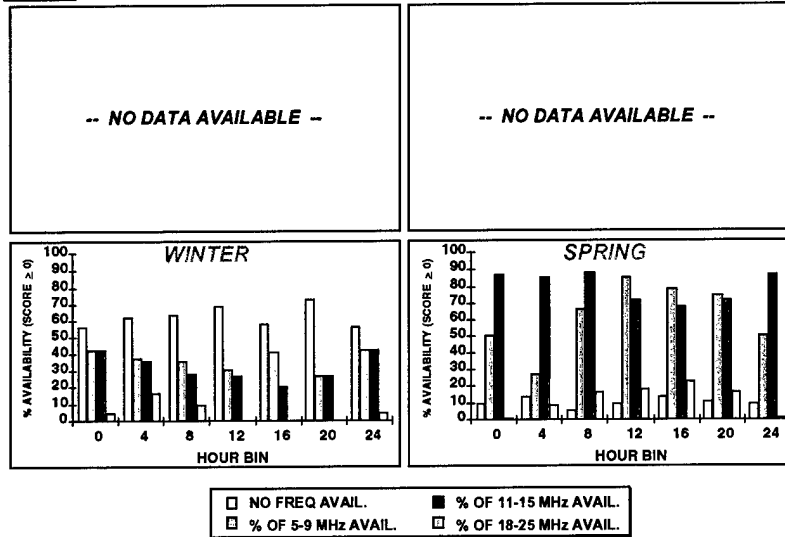


N1810-GA-95(L)0524U.M69

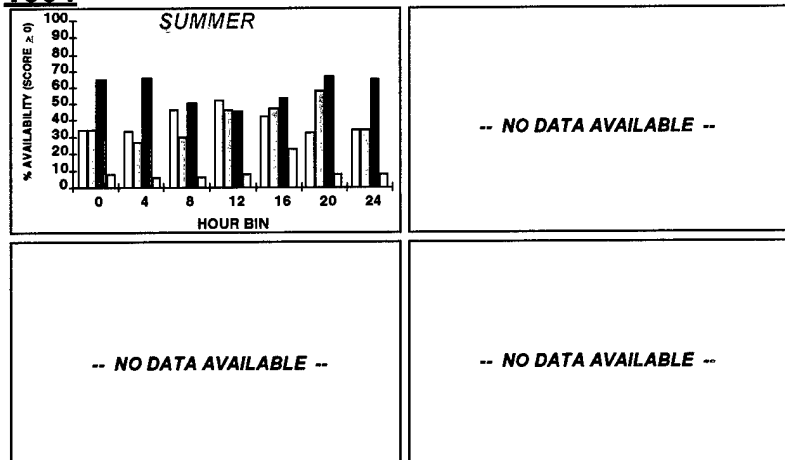
Figure 222. Circuit Availability by Season, Davis to Christchurch, 1993-1994

DAVIS TO MCMURDO

1993



1994

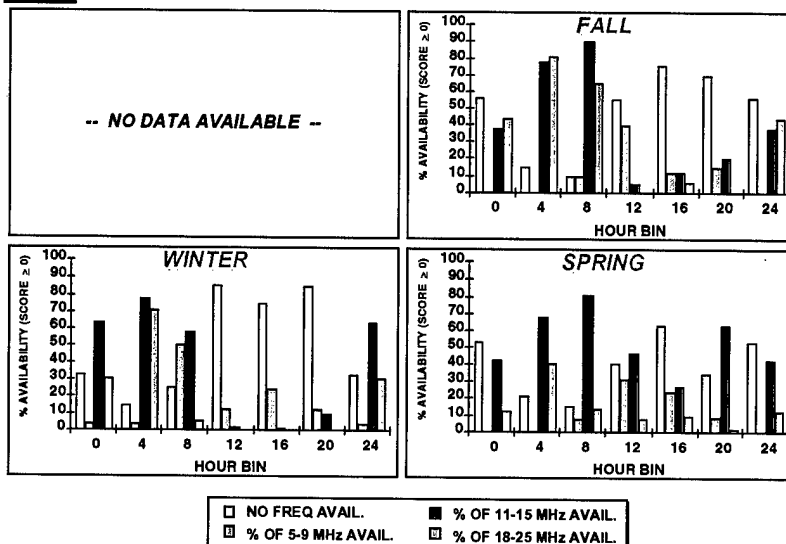


N1810-GA-95(L)0524U.M70

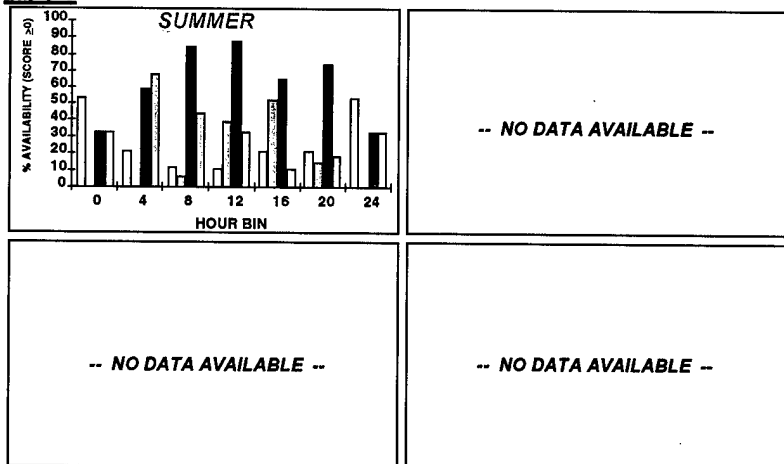
Figure 223. Circuit Availability by Season, Davis to McMurdo, 1993-1994

DAVIS TO SALISBURY

1993



1994



N1810-GA-95(L)0524U.M71

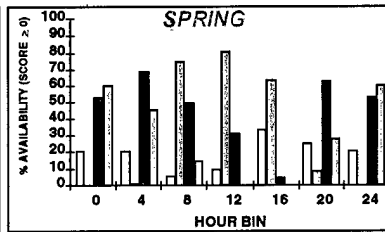
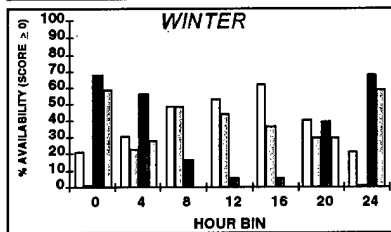
Figure 224. Circuit Availability by Season, Davis to Salisbury, 1993-1994

SALISBURY TO CHRISTCHURCH

1993

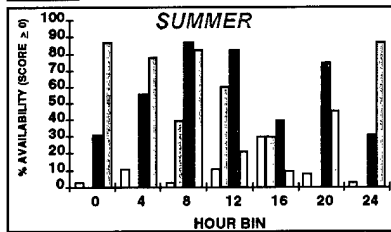
-- NO DATA AVAILABLE --

-- NO DATA AVAILABLE --

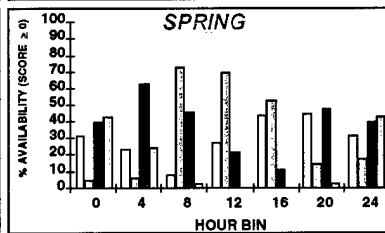
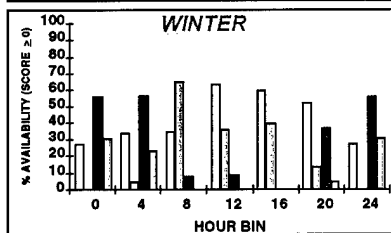


☐ NO FREQ AVAIL. ☐ % OF 11-15 MHz AVAIL.
☐ % OF 5-9 MHz AVAIL. ☐ % OF 18-25 MHz AVAIL.

1994



-- NO DATA AVAILABLE --

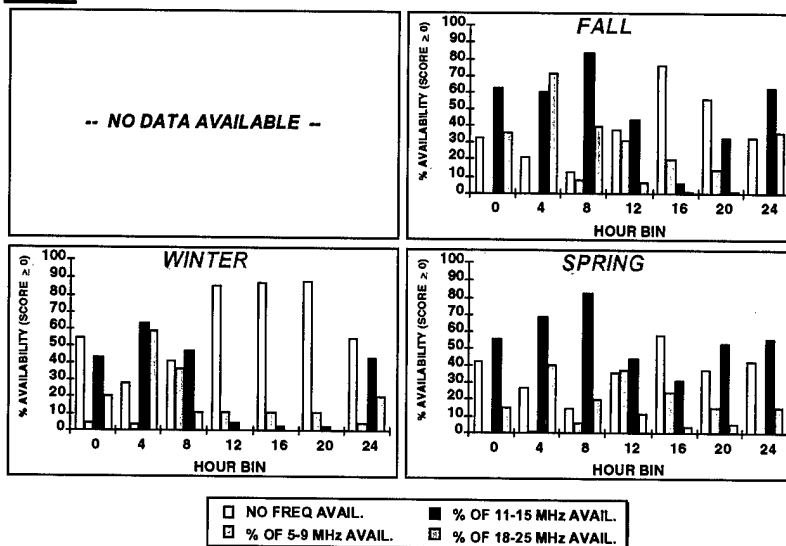


N1810-GA-95(L)0524U.M72

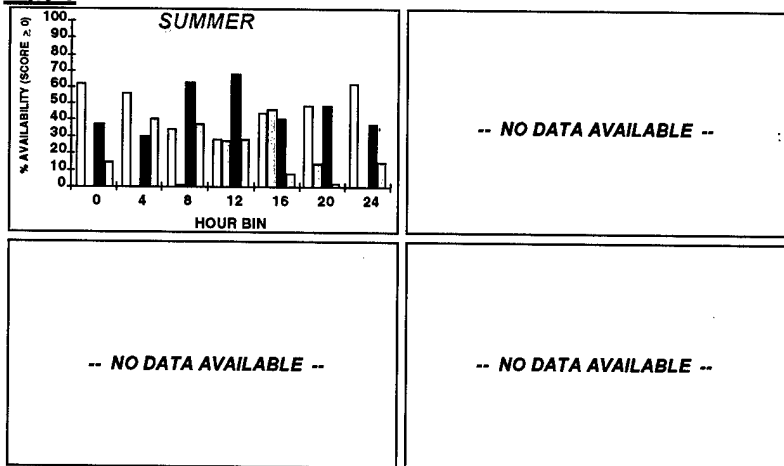
Figure 225. Circuit Availability by Season, Salisbury to Christchurch, 1993-1994

SALISBURY TO DAVIS

1993



1994

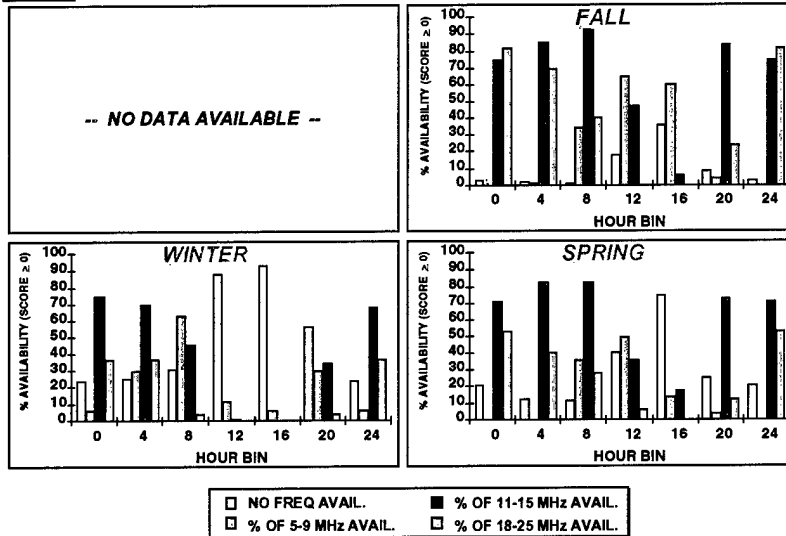


N1810-GA-95(L)0524U.M73

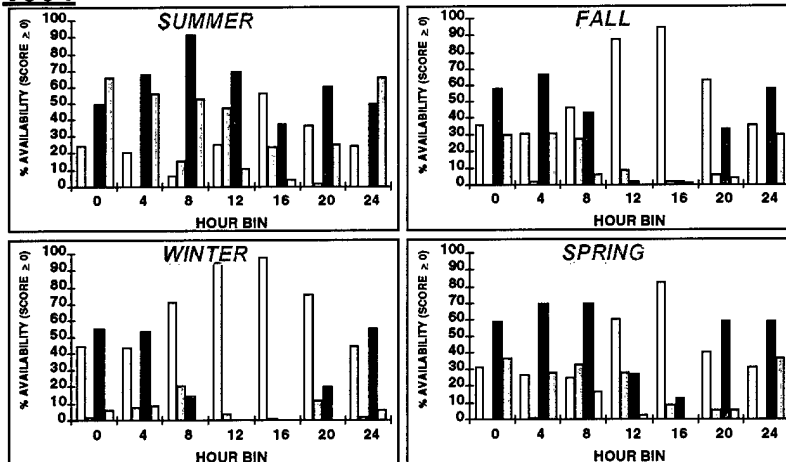
Figure 226. Circuit Availability by Season, Salisbury to McMurdo, 1993-1994

SALISBURY TO MCMURDO

1993



1994



N1810-GA-95(L)0524U.M74

Figure 227. Circuit Availability by Season, Salisbury to Davis, 1993-1994

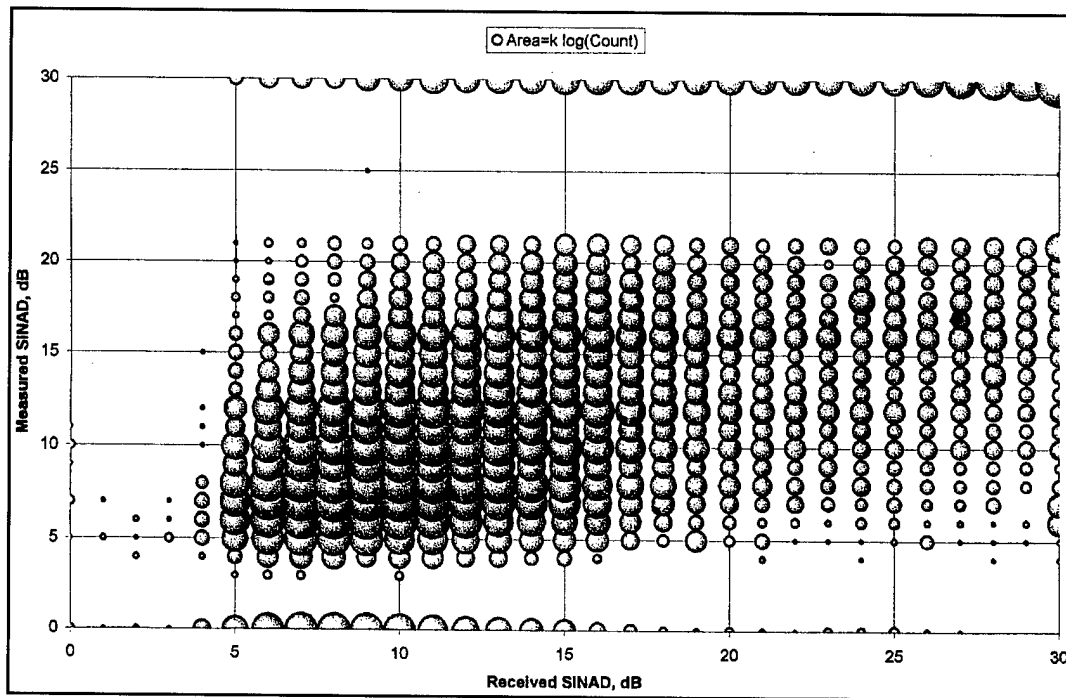


Figure 228. Link Symmetry for All Links, 1993-1994

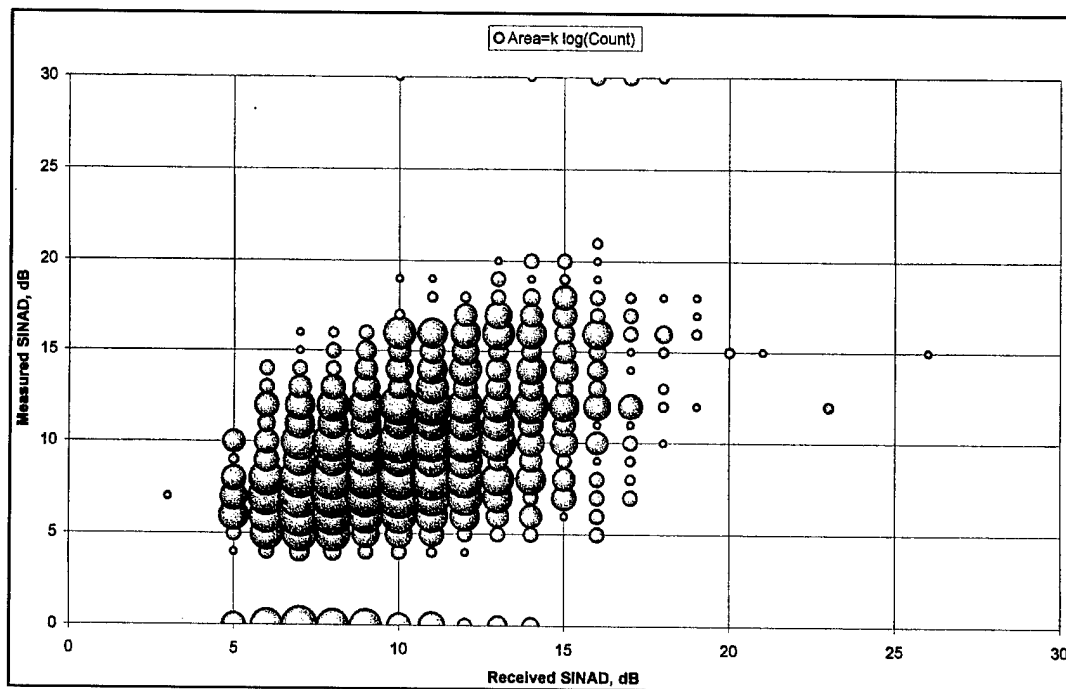


Figure 229. Link Symmetry, Salisbury to McMurdo, 0000-0400 UT

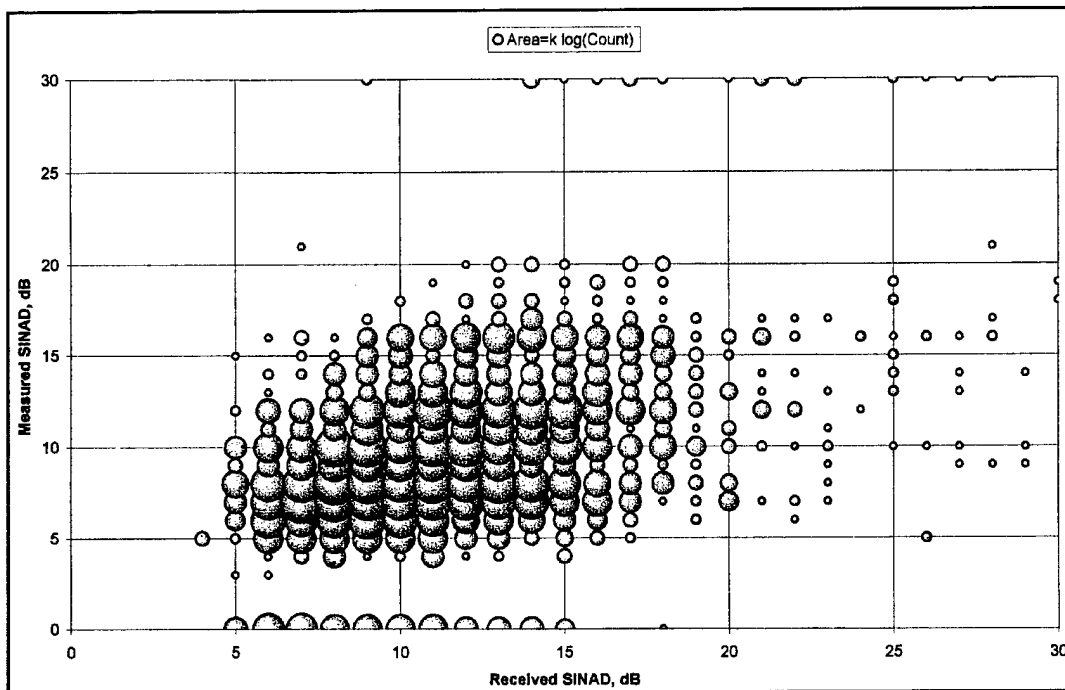


Figure 230. Link Symmetry, Salisbury to McMurdo, 0400-0800 UT

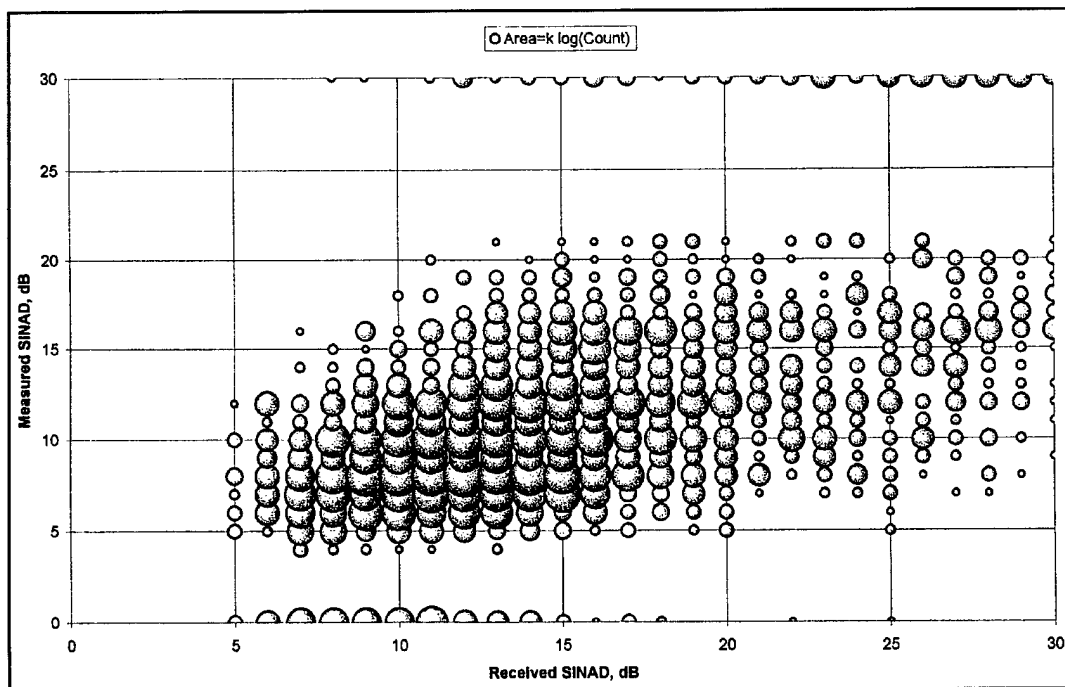


Figure 231. Link Symmetry, Salisbury to McMurdo, 0800-1200 UT

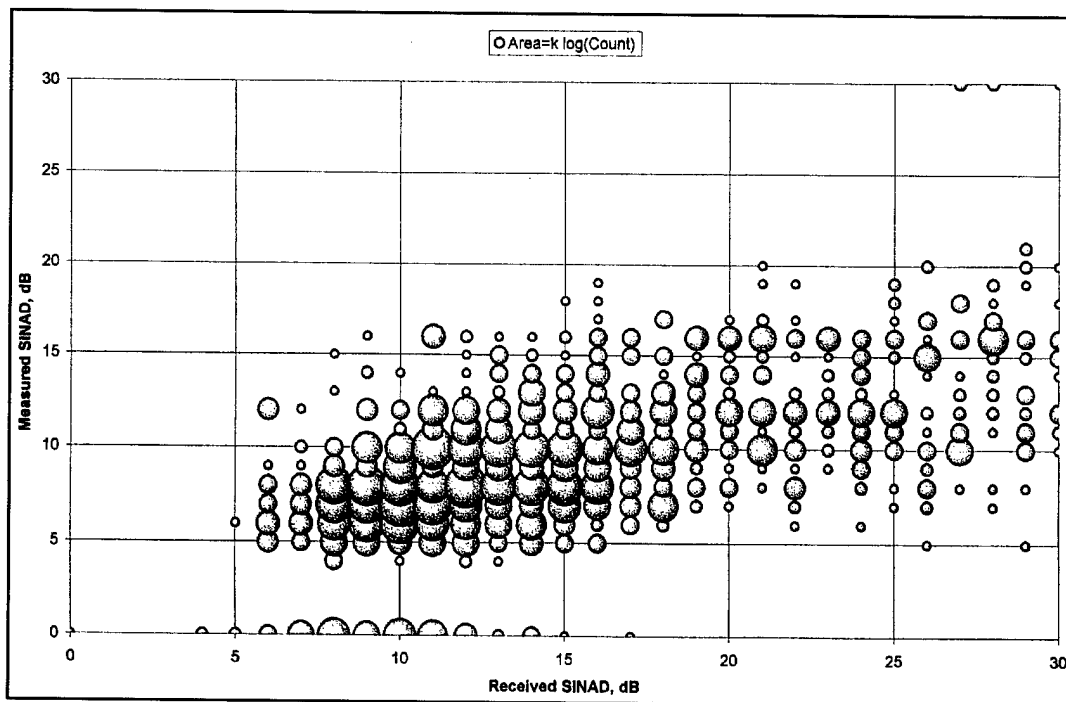


Figure 232. Link Symmetry, Salisbury to McMurdo, 1200-1600 UT

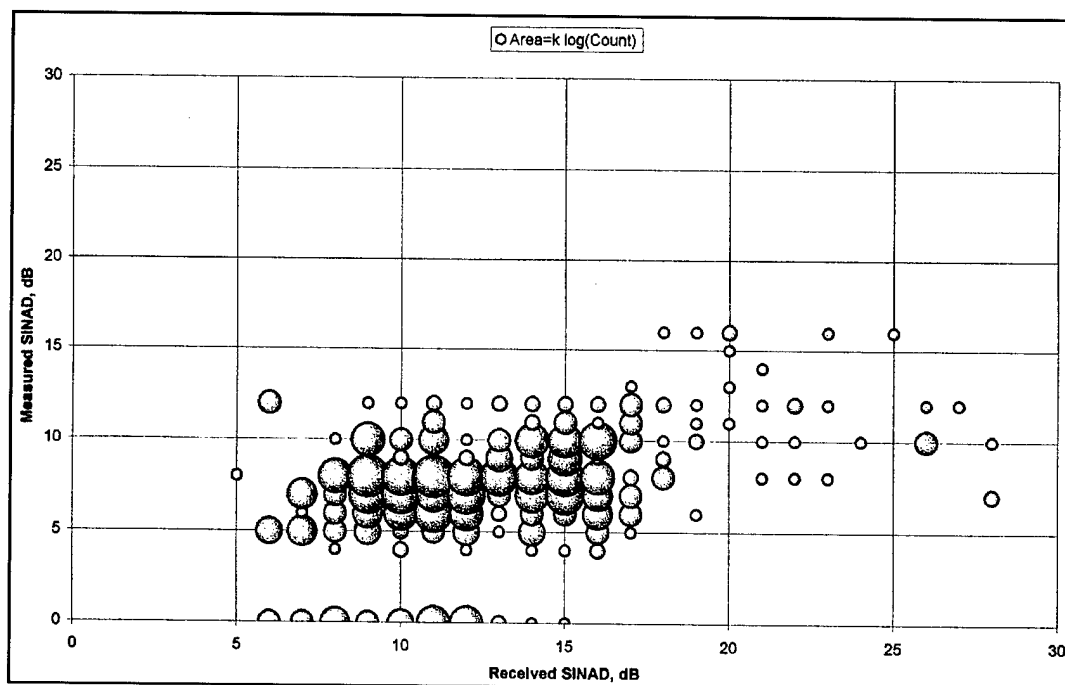


Figure 233. Link Symmetry, Salisbury to McMurdo, 1600-2000 UT

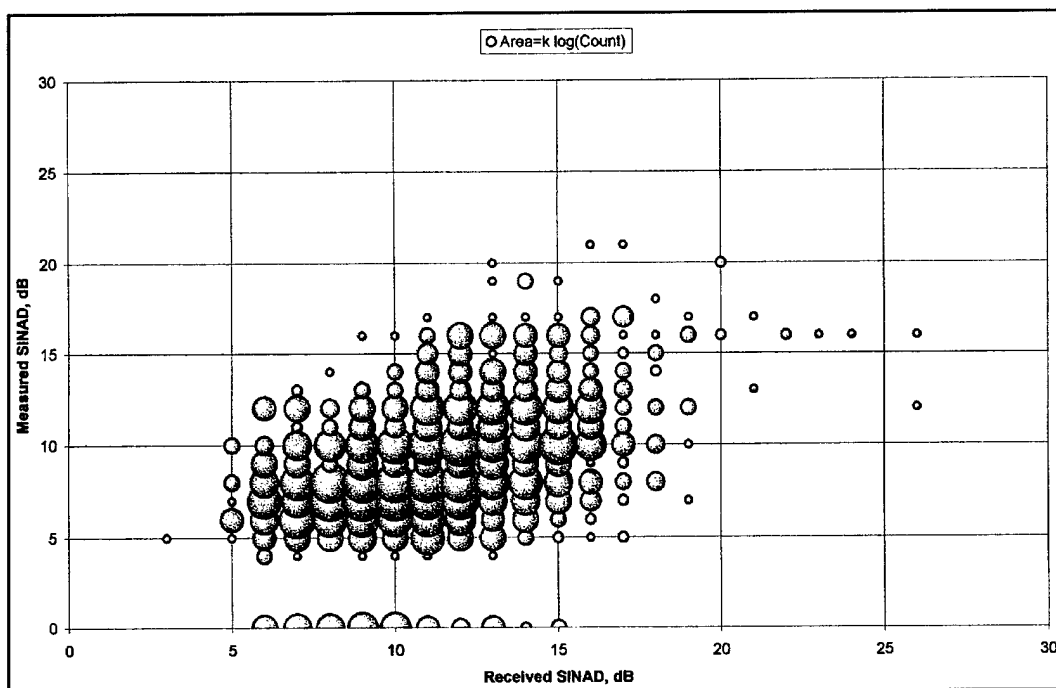


Figure 234. Link Symmetry, Salisbury to McMurdo, 2000-2400 UT

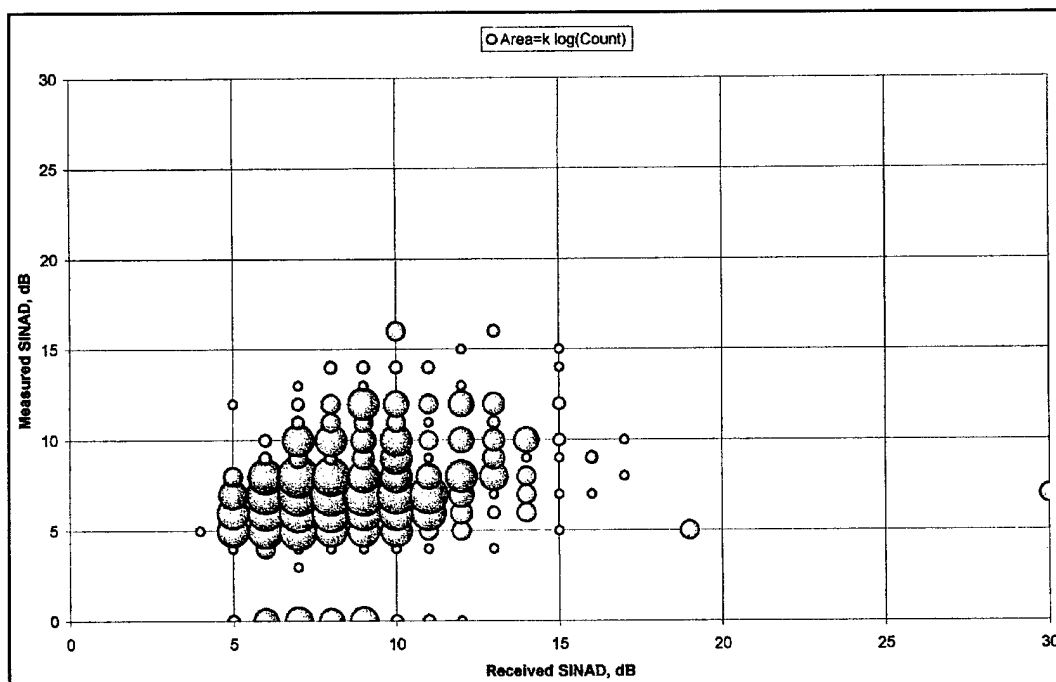


Figure 235. Link Symmetry, Salisbury to Christchurch, 0000-0400 UT

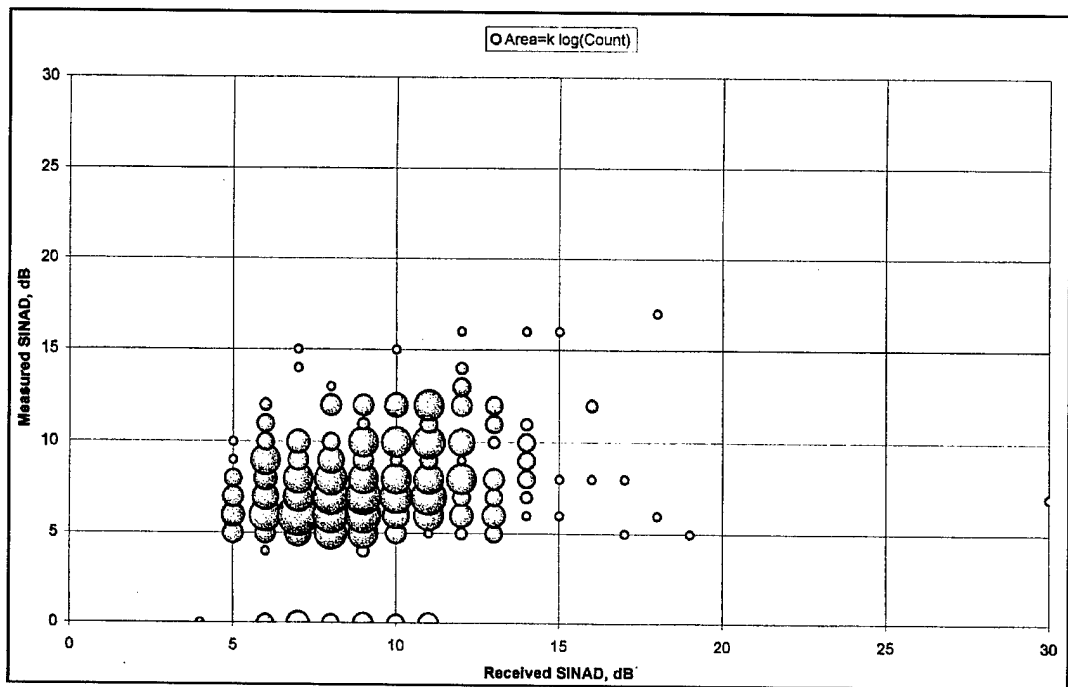


Figure 236. Link Symmetry, Salisbury to Christchurch, 0400-0800 UT

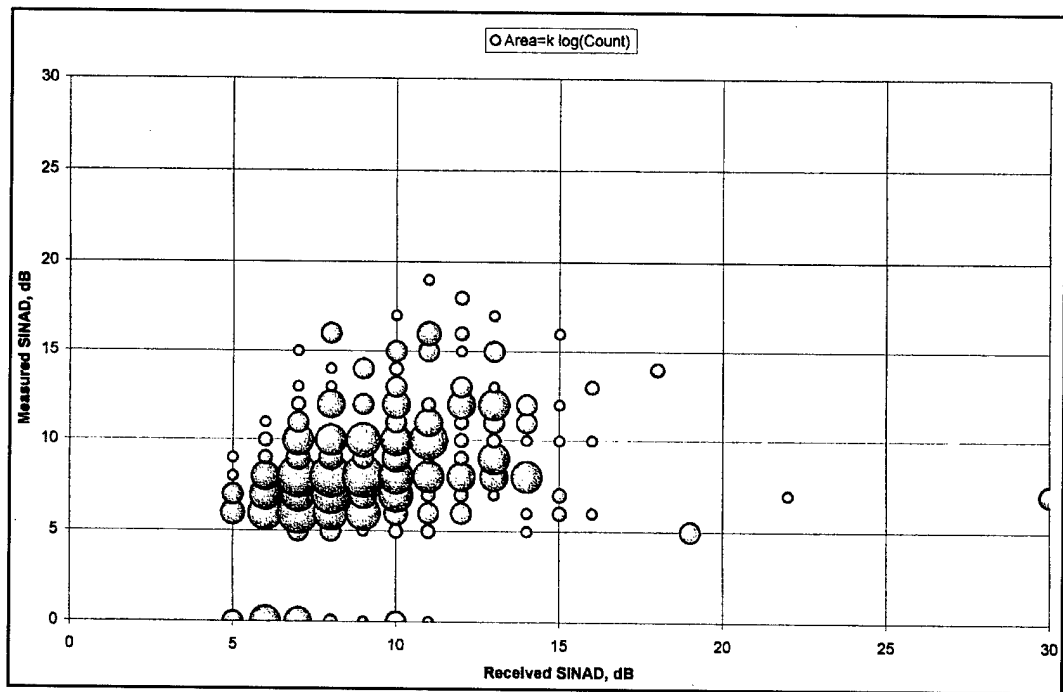


Figure 237. Link Symmetry, Salisbury to Christchurch, 0800-1200 UT

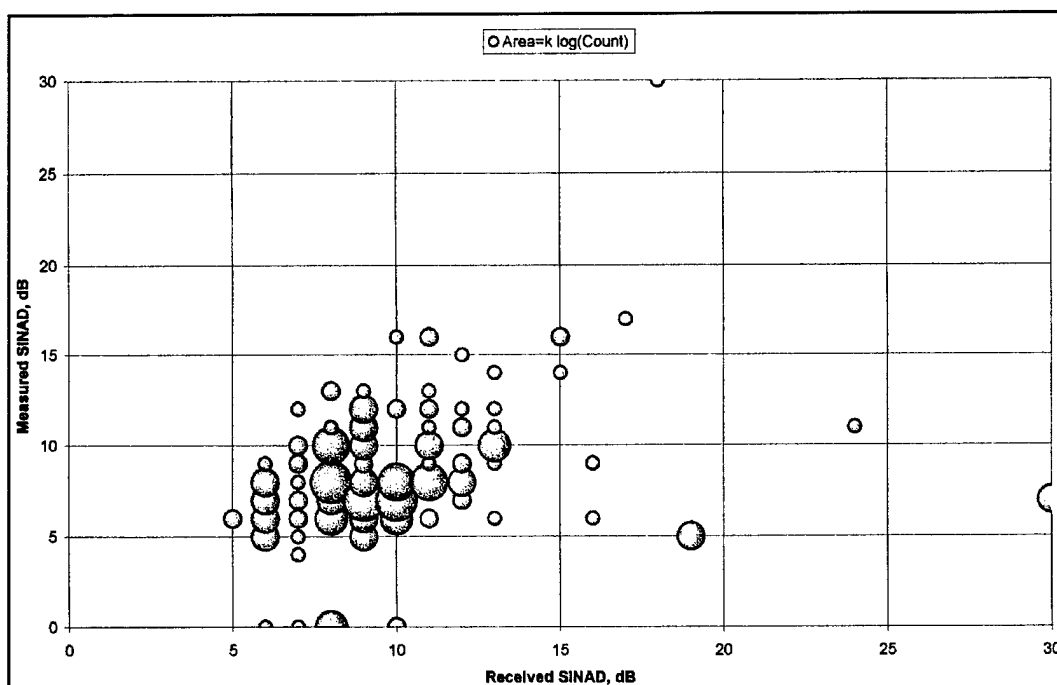


Figure 238. Link Symmetry, Salisbury to Christchurch, 1200-1600 UT

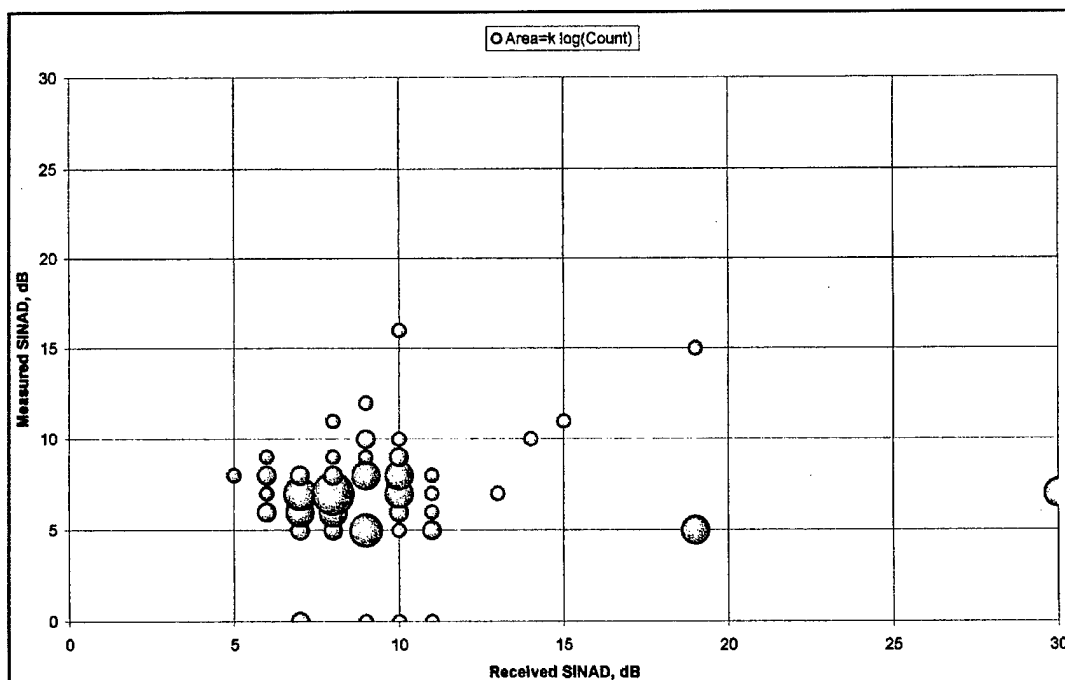


Figure 239. Link Symmetry, Salisbury to Christchurch, 1600-2000 UT

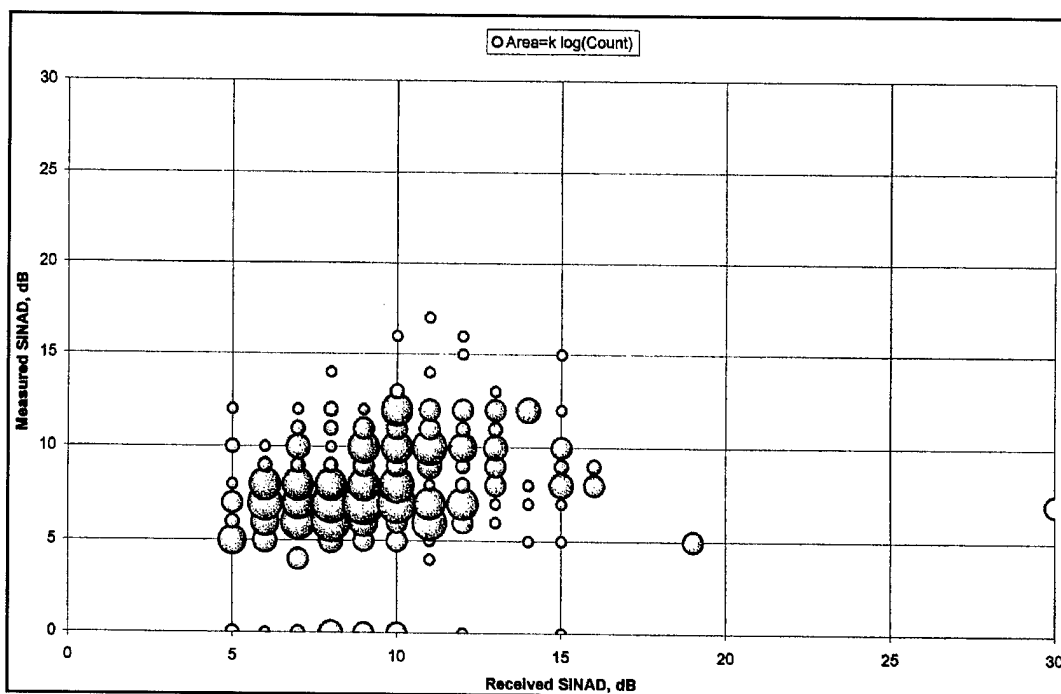


Figure 240. Link Symmetry, Salisbury to Christchurch, 2000-2400 UT

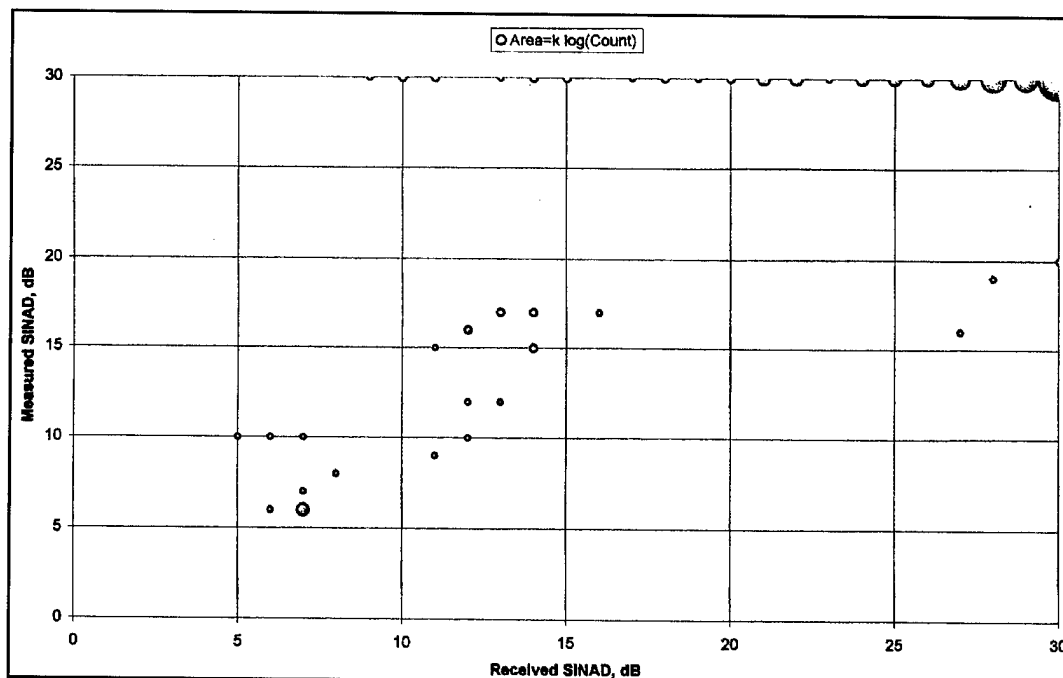


Figure 241. Link Symmetry, Davis to McMurdo, 0000-0400 UT

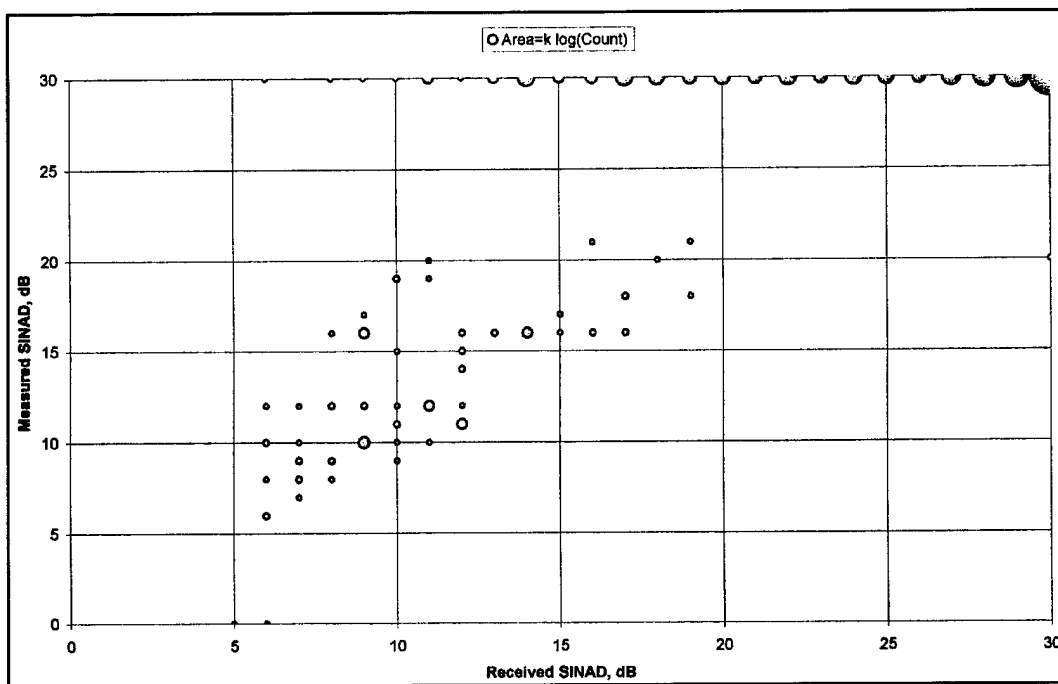


Figure 242. Link Symmetry, Davis to McMurdo, 0400-0800 UT

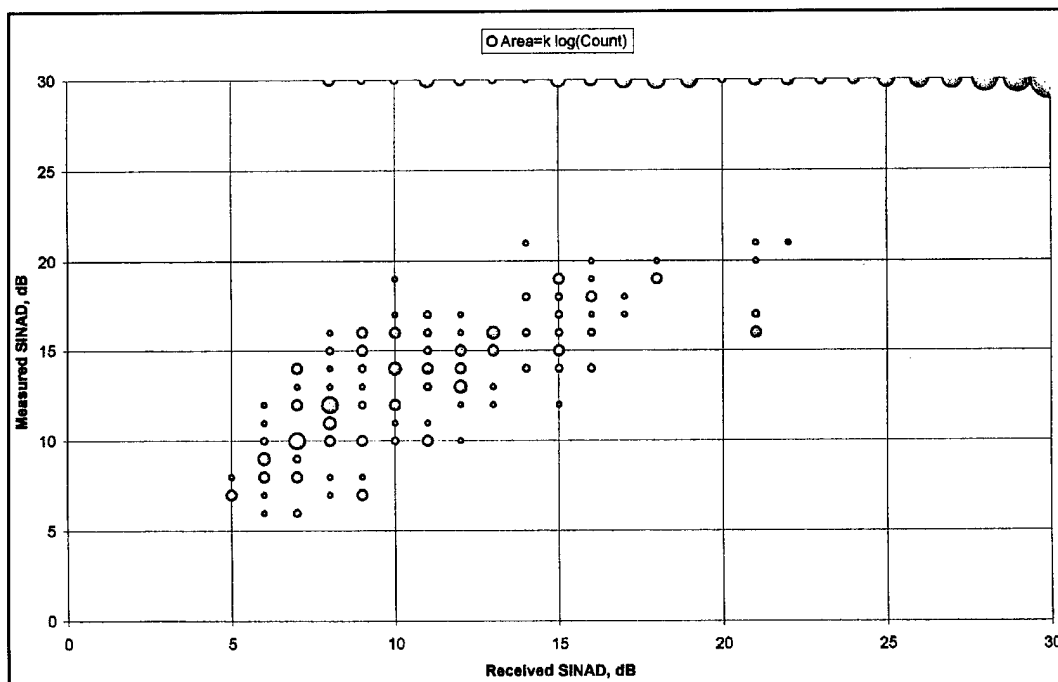


Figure 243. Link Symmetry, Davis to McMurdo, 0800-1200 UT

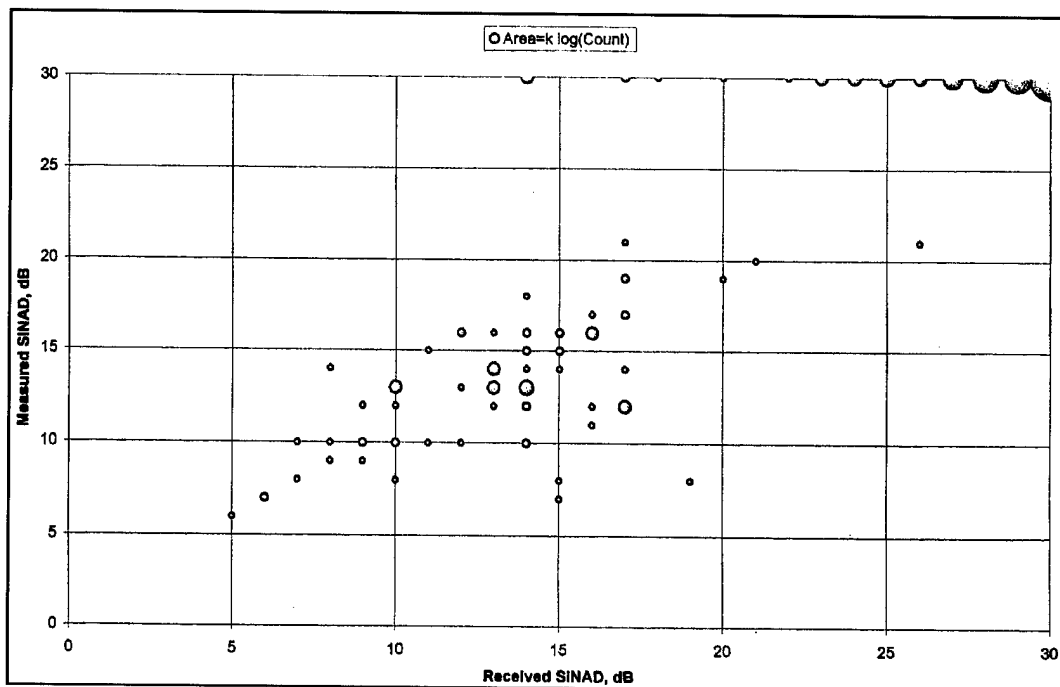


Figure 244. Link Symmetry, Davis to McMurdo, 1600-2000 UT

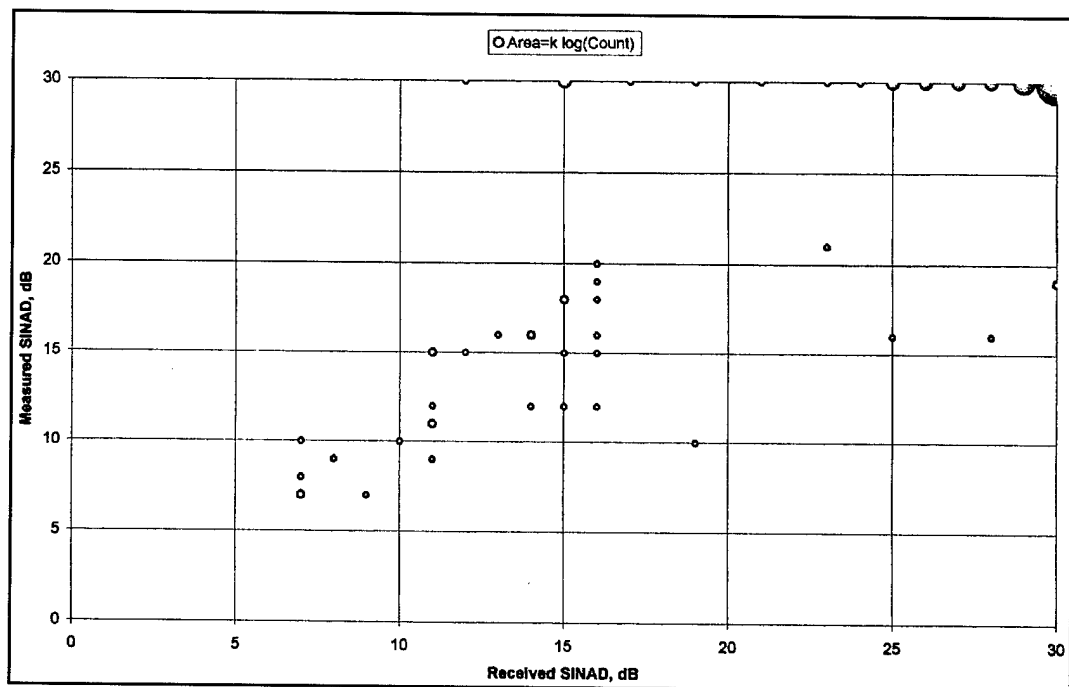


Figure 245. Link Symmetry, Davis to McMurdo, 2000-2400 UT

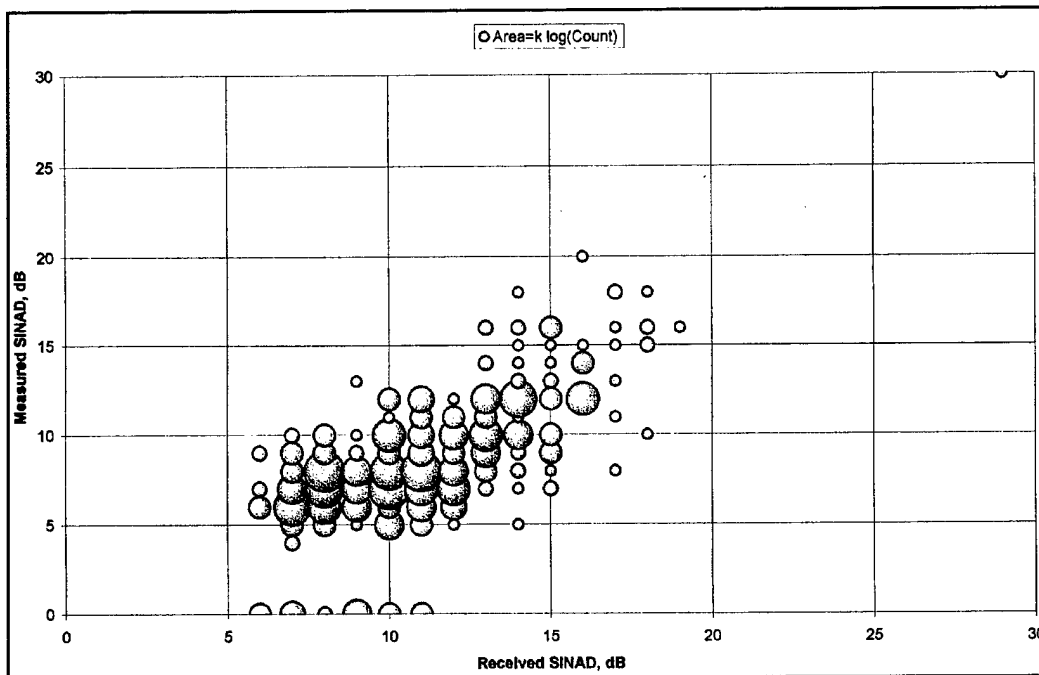


Figure 246. Link Symmetry, Salisbury to Davis, 0000-0400 UT

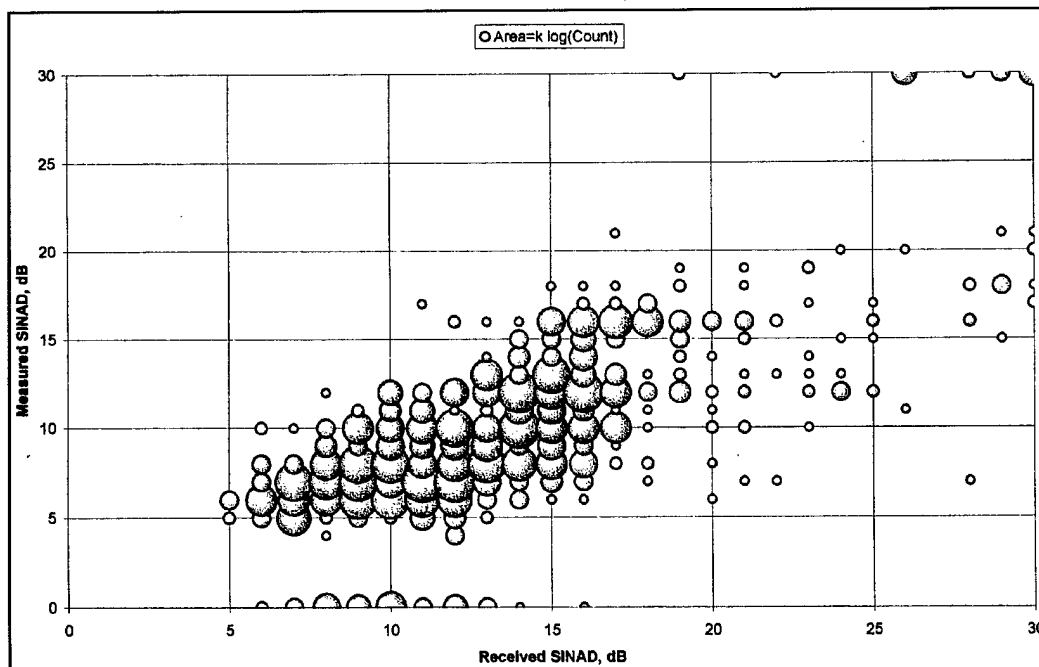


Figure 247. Link Symmetry, Salisbury to Davis, 0400-0800 UT

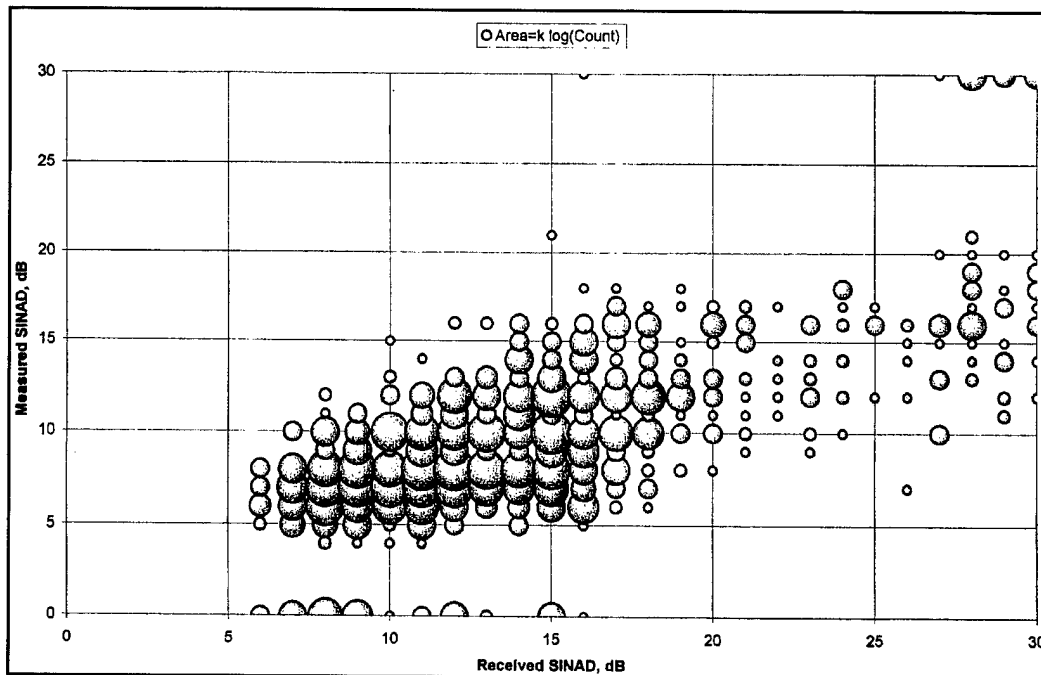


Figure 248. Link Symmetry, Salisbury to Davis, 0800-1200 UT

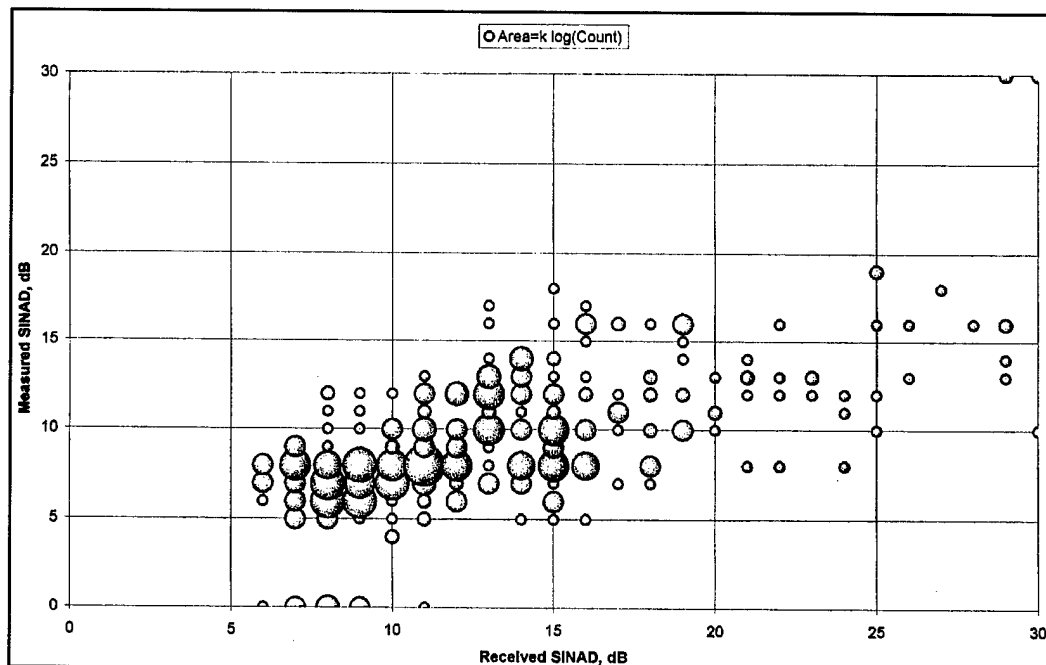


Figure 249. Link Symmetry, Salisbury to Davis, 1200-1600 UT

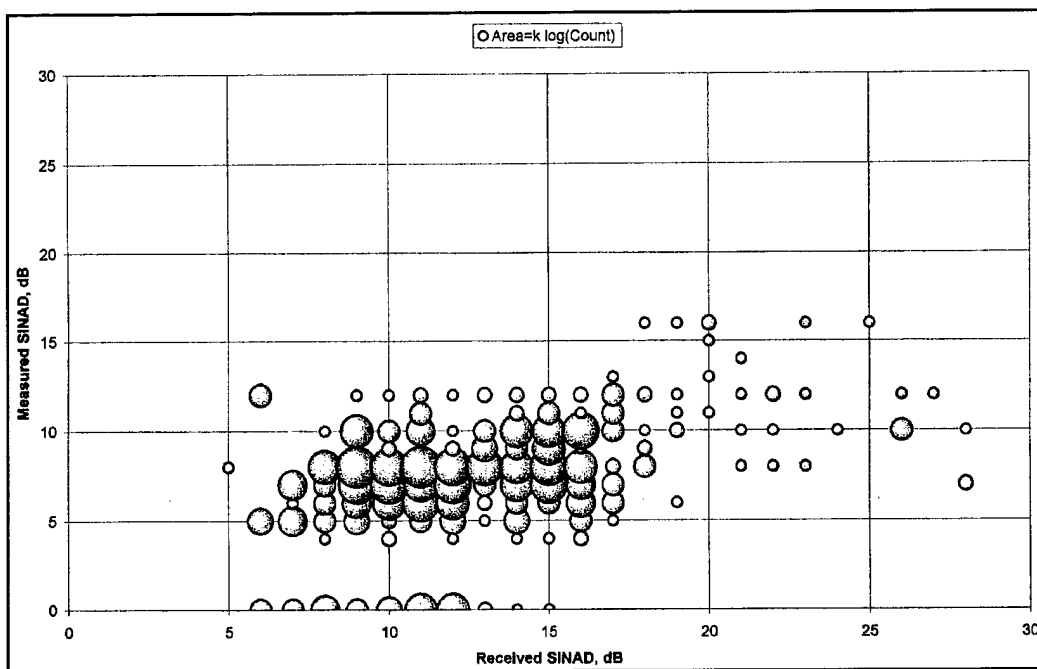


Figure 250. Link Symmetry, Salisbury to Davis, 1600-2000 UT

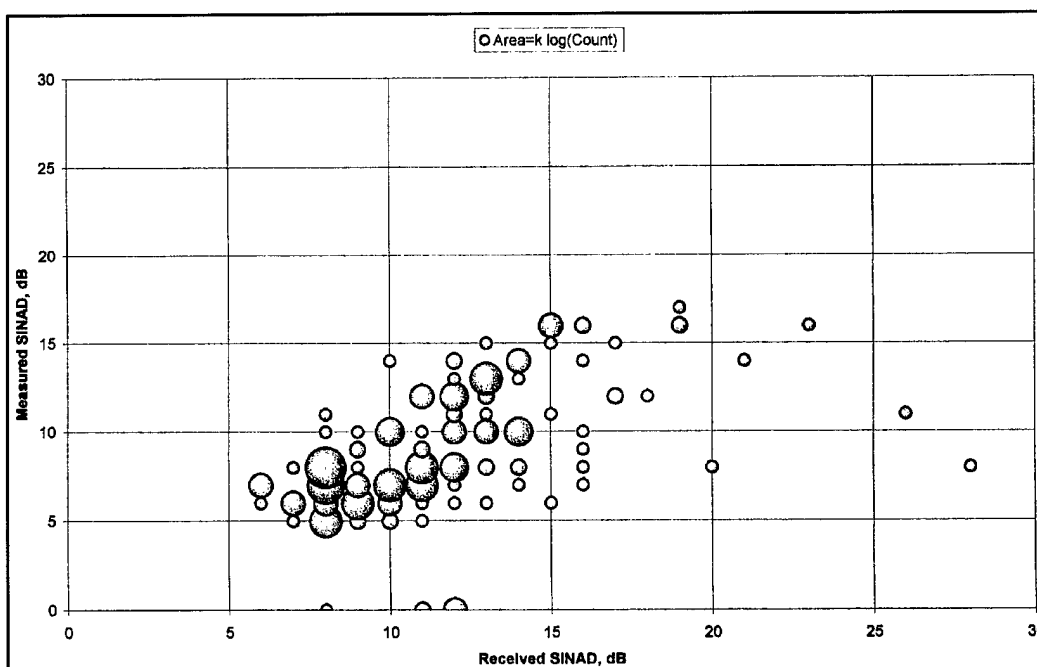


Figure 251. Link Symmetry, Salisbury to Davis, 2000-2400 UT

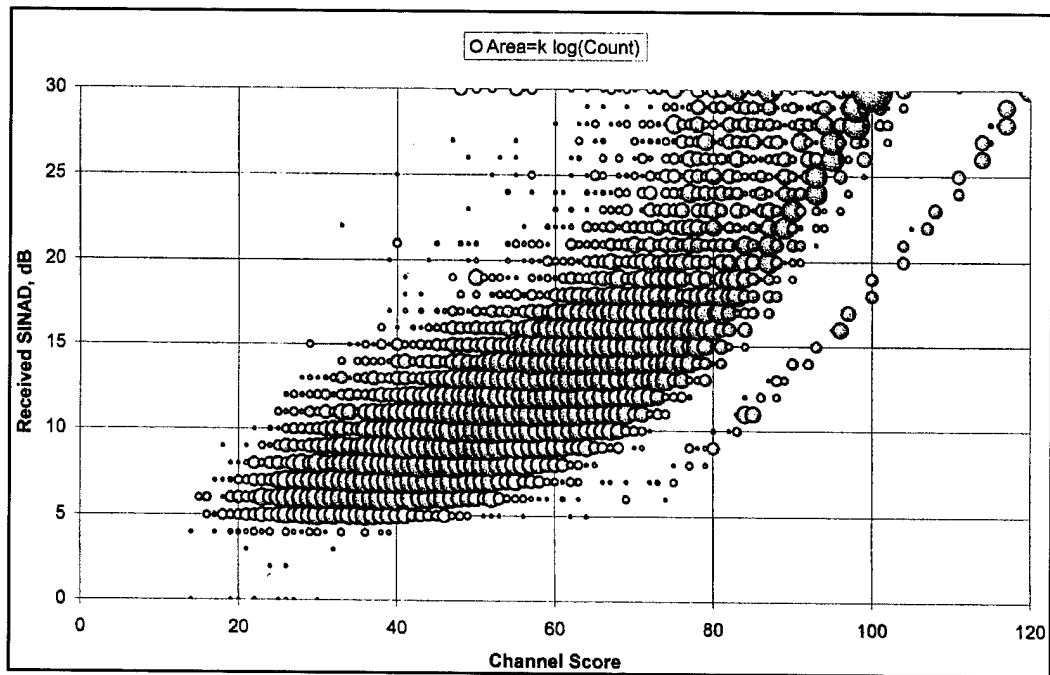


Figure 252. Received SINAD vs. Channel Score

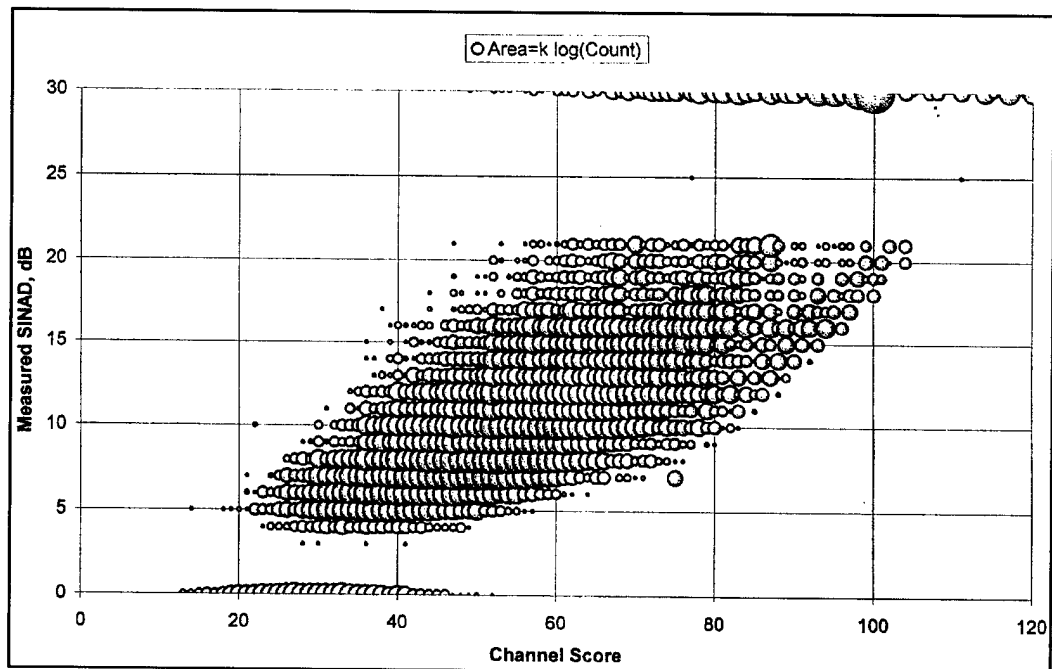


Figure 253. Measured SINAD vs. Channel Score

INITIAL DISTRIBUTION LIST

| Addressee | No. of Copies |
|---|---------------|
| National Science Foundation, Office of Polar Programs | 6 |
| Office of Naval Research (ONR 313) | 2 |
| Defense Technical Information Center | 6 |
| Tele-Technologies, Inc. (Robert Pellowski) | 1 |
| Joseph Katan | 3 |
| John Tillbrook | 1 |

INITIAL DISTRIBUTION LIST

| Addressee | No. of Copies |
|---|---------------|
| National Science Foundation, Office of Polar Programs | 6 |
| Office of Naval Research (ONR 313) | 2 |
| Defense Technical Information Center | 6 |
| Tele-Technologies, Inc. (Robert Pellowski) | 1 |
| Joseph Katan | 3 |
| John Tillbrook | 1 |